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ORIGINAL MEMOIRS.

MYOSITIS OSSIFICANS TRAUMATICA.*

A REPORT OF THREE CASES ILLUSTRATING THE DIFFICULTIES OF
DIAGNOSIS FROM SARCOMA.

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OF NEW YORK.

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CASE I.—*Myositis ossificans traumatica of quadriceps extensor*.—J. B. N., the patient, a boy of nineteen, had always been in good health up to November 17, 1906, when he received an injury to his right thigh while playing football. There was no external evidence of the injury noticeable that night, but the next day there was some swelling; two to three days later the leg became stiff, and the stiffness seemed to be confined to the region of the quadriceps muscle, greatly limiting the flexion at the knee. There was no pain at any time, but the swelling steadily increased in size. The patient at first believed the swelling to be in the muscle rather than the bone. The swelling slowly began to get hard and contract; the patient's general condition remained unimpaired. He was examined by a number of prominent surgeons and all agreed that the trouble was sarcoma, and amputation was advised. My opinion was asked by letter, and I replied that if the trouble was sarcoma I would advise a brief course of the mixed toxins treatment before amputation. Thereupon the toxins were administered for about four weeks with little reaction and no apparent effect on the size of the tumor. I declined to give further advice without seeing the patient, and he

* Read before the New York Surgical Society, December 11, 1912.

was referred to me early in April, 1907, by Dr. Wm. D. Haggard, of Nashville, Tenn. Physical examination showed a tumor situated in the middle and lower thirds of the anterior portion of the shaft of the left femur. The consistence of the tumor was extremely hard, much harder than usual in periosteal sarcoma. The X-ray photograph showed a sharp line of demarcation between the tumor and the shaft of the femur along the periosteal line, with no indentations in the periosteum. I made the diagnosis of myositis ossificans and under ether removed a piece of the tumor for microscopical examination, and advised no further treatment. The patient has continued in good health up to the present time, 5 $\frac{3}{4}$ years later. The specimen was examined by Dr. Jas. Ewing, Professor of Pathology at Cornell University Medical School. This report reads as follows:

April 12, 1907: Material received consists of several small masses of bony tissue. After hardening in Müller-formol and decalcifying, sections were stained in eosin and hæmatoxylin. The tissue is composed of numerous trabeculæ of bone, round, elongated, branching, and anastomosing, as in cancellous tissue. These masses are usually well calcified, but some are deficient in ossification, in the centres where the material stains bluish. They are often surrounded by numerous large osteoblasts which are evidently in the process of bone formation. In a few areas there are scanty giant osteoblasts, lying in lacunæ or at some distance from the bone tissue. Between the bony trabeculæ the tissue is composed of cellular connective or of fat. The connective tissue is very cellular and appears to be of new formation. The fat tissue is inflamed, infiltrated with new cells, chiefly lymphocytes, and the fat is being absorbed. There are no traces of muscle tissue in the section.

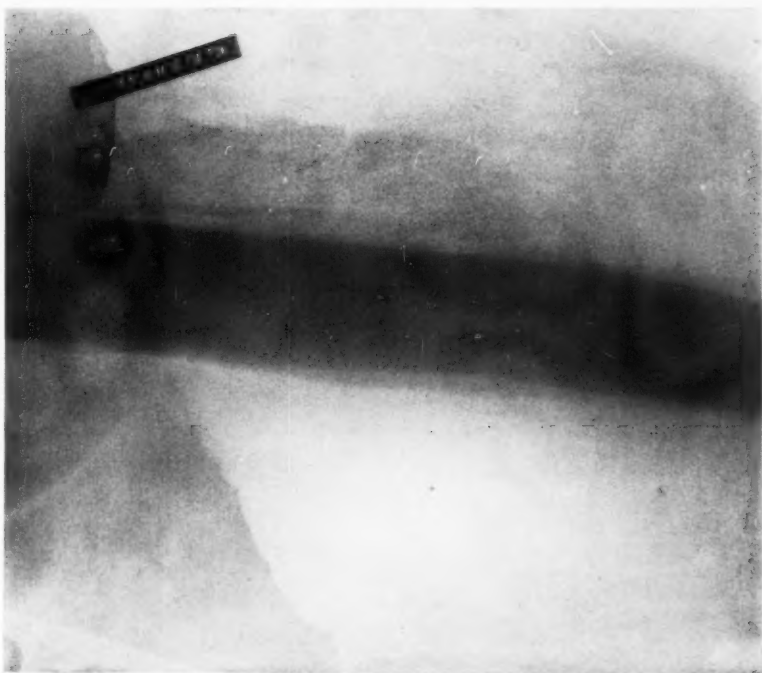
Dr. Ewing stated that the condition was one usually termed myositis ossificans traumatica, though chronic productive osteitis might be a better term.

Under date of November 13, 1912, the patient writes:

"On palpation I cannot notice much reduction in size of the growth. The interference with movement is very slight, being able to almost completely flex my leg. It gives me no trouble at all, save for an occasional slight uneasiness just sufficient to attract one's attention. My general health is good."

The first X-ray illustration shows the condition prior to operation.

The second X-ray photograph, taken by Dr. A. F. Holding,



Myositis, ossificans, 1907. (Case I.)



5 3/4 years later, December 1912. (Case I.)



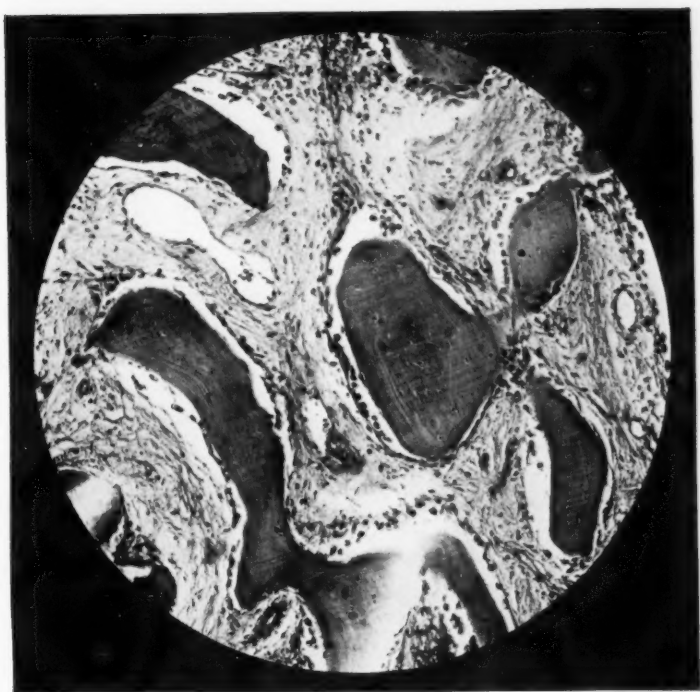
Myositis ossificans. (Case I.)



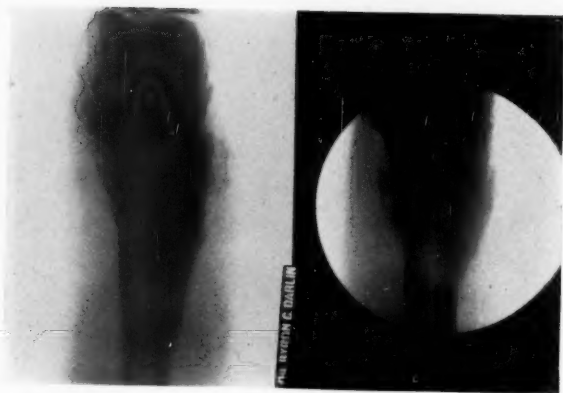
Myositis ossificans. (Case I.)



Myositis ossificans, 1907. (Case I.)



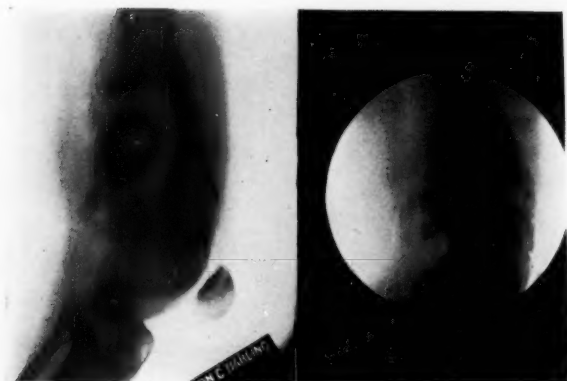
Myositis ossificans, 1907. (Case I.)



Interval, 2 years 2 months—May, 1909-July, 1911. (Case II.)



Normal knee. (Case II.)



Interval, 2 years 2 months—May, 1909-July, 1911. (Case II.)

December 11, 1912, shows the condition almost identical with the second radiograph of Mr. Makins's case, taken six years afterward. It shows that much of the original bony tumor has been absorbed.

NOTE.—The patient, now a physician, was shown before the New York Surgical Society Dec. 11, 1912.

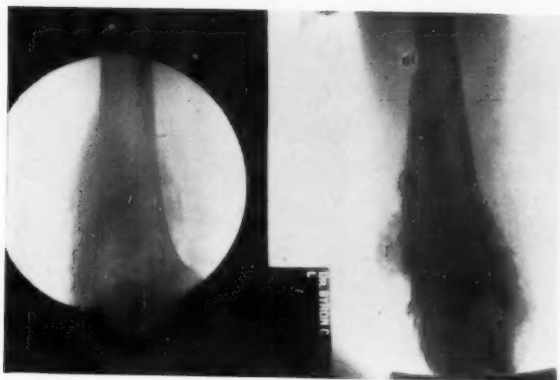
CASE II.—*Myositis ossificans of muscles and ligaments, lower end of femur, becoming sarcoma six years later.*—The patient, Miss A., aged twenty-six, had always been in good health; negative family history. Seven years ago she was thrown from a carriage in a runaway accident, and received a very severe blow on the lower and outer part of the left thigh, just above the knee. After the immediate effects of the contusion had subsided she noticed nothing unusual until about two years later, when, on bathing, she saw that the left thigh just above the knee was somewhat larger than the right. There was no pain, no soreness, no lameness, the increase in size being the first sign she noticed. She consulted a physician who found a slight bony enlargement above the outer condyle of the left femur and an X-ray photograph was taken at that time, which showed a small bony tumor projecting about half an inch beyond the normal border of the shaft of the femur, not extending to the joint. This increased in size very slowly, was not painful and caused her no trouble. On February 9, 1909, the patient consulted a very prominent surgeon of the Middle West, who pronounced it subperiosteal sarcoma and advised hip-joint amputation. She was made very nervous by this decision and went abroad for two months to get in better physical condition. On her return, on May 3, she again consulted another very prominent physician of Chicago, who stated that she was suffering from a fibrosarcoma of the femur of periosteal origin. He stated that there was no possible doubt of the diagnosis and advised immediate amputation below the trochanter and urged this being done without a day's delay. She was brought to me for advice on May 5, 1909, by her family physician, Dr. Mary Spark of Indianapolis. Physical examination showed the patient in good general condition; examination of the left thigh showed a hard, bony tumor in the lower third of the left femur, smooth in outline, extending upward about two and a half inches, most marked on the outer side. Although it extended apparently nearly around the bone, the skin was perfectly normal in appearance and there were no enlarged veins. Comparison between the X-ray taken

a year ago and that of a few days ago showed some increase in size and extension across toward the other side of the femur; no involvement of the joint, and interior of bone not involved.

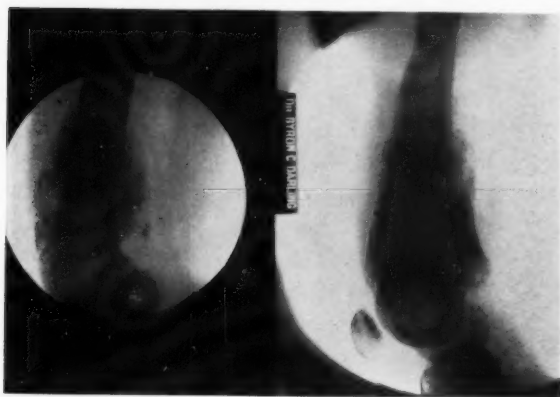
In both these cases there was a well-defined sharp line of demarcation between the bone and the tumor, differing strikingly from the irregular indentation almost always present in the case of sarcoma. The consistence of the tumor, too, was much harder and more bony in character than in true sarcoma. I believed the tumor to be some type of myositis ossificans originating from the trauma, and not sarcoma. I advised an exploratory incision under general anæsthesia and removal of a section of the tumor for microscopic examination. This was done on May 7. An incision three inches in length was made over the external condyle, the most prominent part of the tumor; on cutting through the fascia overlying the muscles and separating the latter, no periosteum could be recognized, a hard, bony tumor was found in close proximity to, and infiltrating, the muscles. A portion of this was removed with a chisel. Macroscopically it had every appearance and the consistence of cancellous bone tissue, deep red in color and in no way resembling the grayish-white appearance of sarcoma. This was sent to Dr. James Ewing, Professor of Pathology at Cornell University, who, after decalcification, made a careful examination and reported as follows:

May 17, 1909: Seven different portions of the material received are under examination. In none of them is there the slightest trace of any form of sarcoma. The tissue shows chronic osteitis and myositis, such as commonly arises after traumatism to the bone or periosteum. The changes in the muscle are not those typical of myositis ossificans and yet new bone appears to be forming in close proximity to the atrophying muscle. I should prefer to give the diagnosis of chronic formative osteitis.

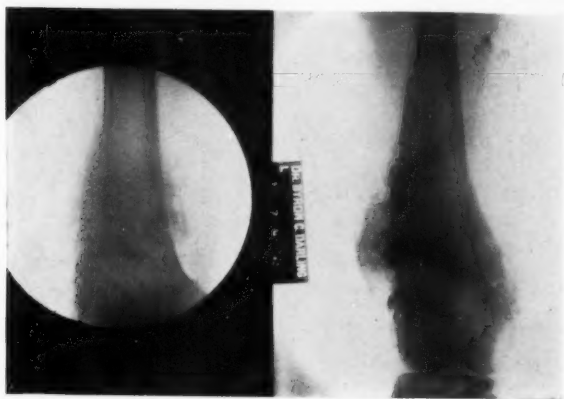
The history of this case thus far was related in my paper on "A Plea for More Conservative Treatment of Sarcoma of the Long Bones" (*Jour. of the Am. Med. Ass'n*, Jan. 29, 1910), but it is the later history of the case that has proved of particular importance and which makes it, as far as my own search of the literature goes, an entirely unique case.



Interval, 2 years 5 months—May, 1909-October, 1911. (Case II.)



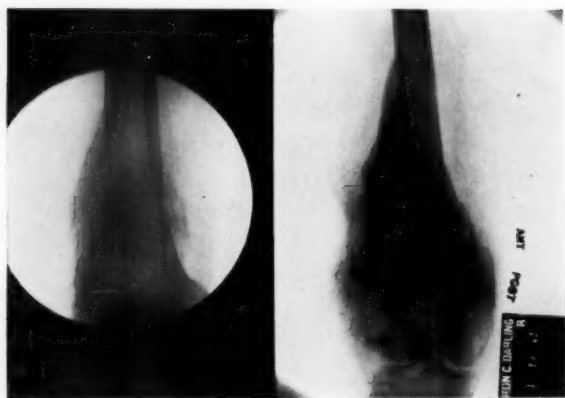
Interval, 2 years 5 months—May, 1909-October, 1911. (Case II.)



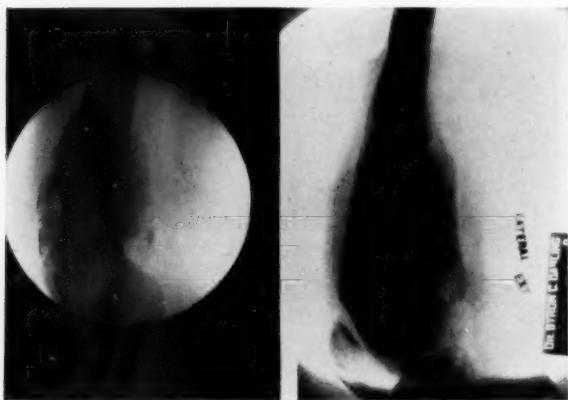
Interval, 2 years 8 months—May, 1909-January, 1912. (Case II.)



Interval, 2 years 8 months—May, 1909—January, 1912. (Case II.)



Interval, 2 years 11 months—May, 1909—April, 1912. (Case II.)



Interval, 2 years 11 months—May, 1909—April, 1912. (Case II.)

The wound healed by primary intention, and at the end of two weeks the patient returned to her home in the Middle West. She continued to enjoy perfect health and was able to ride horseback and play golf without any inconvenience. Two years later, in June, 1911, she called upon me while passing through the city and I examined the knee carefully. Physical examination showed a slight increase in the bony enlargement at the outer and posterior side of the femur and some thickening of the entire lower end of the shaft, just above the joint surface. There was very slight limitation in motion of the joint, and her general health was excellent. The tumor seemed to be of bony hardness, entirely different in consistency from the ordinary sarcoma. There was practically no change in its appearance from that of two years ago, except the slight increase in size already noted. An X-ray taken at this time by Dr. Darling and compared with the X-ray taken two years before also showed some increase in size and a less sharply defined periosteal line. I advised the patient to see me again in the fall on her return from the country, in order to have another examination made and X-ray taken. Owing to my absence in Europe, I did not see her until January, 1912. At this examination the enlargement seemed even more appreciable than it had been in June and I strongly advised another exploratory operation, thinking that possibly some change had taken place in the nature of the tumor. On January 8, assisted by Dr. Wm. A. Downes, my associate, I made an incision six inches long over the outer aspect of the lower end of the femur, and found a very hard, bone-like swelling, firmly fixed to the femur, in its upper portion, but in its lower portion there seemed to be a mass about the size of an olive that was slightly movable. This proved to be a bony tumor of typical cancellous structure, so hard that it could be cut only with a chisel. It was in no way connected with the periosteum or the femur, but apparently originated in the fascial portion of the adductor muscles just above their insertion, very closely attached to yet distinct from the larger bony mass which was continuous with the shaft of the femur. The smaller tumor was removed and the larger tumor mass was chiseled off on the anterior, lateral, and posterior portions, down to the level of the normal line of the femur. Nearly half a teacupful of bony material was removed, which, macroscopically, had the appearance

of healthy red normal cancellous bone, and in no place was there anything in any way resembling or even suggesting sarcomatous growth. All the material was sent to Dr. Jas. Ewing, Professor of Pathology at Cornell University Medical School, who, after careful examination, made the following report:

Feb. 15, 1912: The tissues in the case of Miss A. show the usual and some unusual changes of myositis ossificans. The process begins with fibrosis and atrophy of the muscle-fibres and the production of dense connective tissue. This is then followed by increased vascularity, and many islands of bone and some of cartilage are deposited. In the new connective tissue there are many very cellular areas with giant-cells which resemble those seen in giant-cell sarcoma. I do not think the process can be regarded as a tumor in all respects, but these cellular areas explain why it is persistent and progressive. It is on this evidence also that many assume that myositis ossificans is a true tumor process. At any rate I do not like the presence of these large cell groups. In all other respects the case is typical of active myositis ossificans.

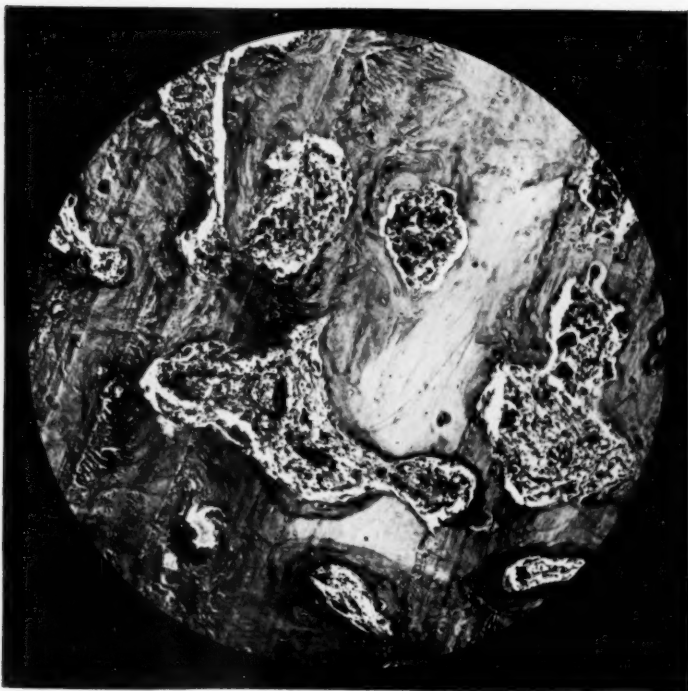
The skin wound was closed, with a gauze packing into the cavity which was of considerable size. The wound healed without any suppuration, and after ten days the patient was allowed to get up and rest upon a couch. A small drain was kept in the cavity for about six weeks, and finally the opening closed entirely. At the end of eight weeks the patient was allowed to go about on crutches. She seemed to have less power in the leg than was to have been expected, and there were occasional attacks of pain which had never occurred before. Two days before the patient's departure for home, there suddenly appeared a moderate effusion in the joint. The latter was strapped and bandaged and she was instructed not to use the leg for a few days, after which the swelling nearly subsided. She then (February 22, 1912), returned to her home in the Middle West, but the pain continued, she developed a slight temperature, 99°-100°, and a swelling appeared over the central portion of the incision at the site of the drainage opening. This swelling increased daily, the pain became more severe, and becoming somewhat nervous about her condition, she returned to New York on March 20. Physical examination at this time showed a marked protuberance over the whole line of incision, greatest at the central point, amounting to a projection of 1-1½ inches over the normal surface. The skin was smooth in outline, slightly purplish from enlargement of superficial veins, and semifluctuat-



Myositis ossificans. Microscopical section, May, 1909. (Case II.)



Central portion ivory-like bone. Giant-celled sarcoma at lower and external portion. March, 1912. Death from metastases in pelvis and spine, January 12, 1913. (Case II.)



Myositis ossificans, January, 1912. (Case II.)



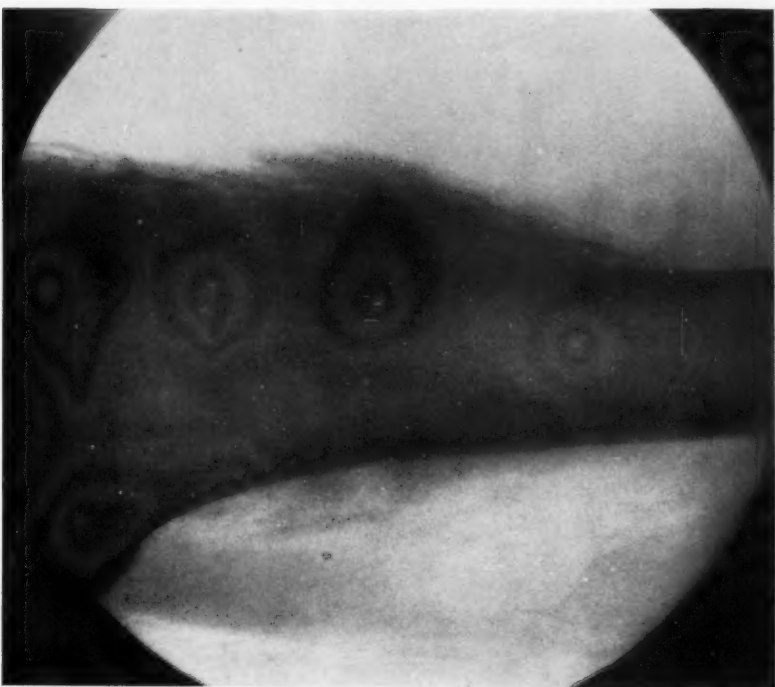
Giant-celled sarcoma, March, 1912. (Case II.)



Myositis ossificans. Fungating sarcoma developing at site of exploratory incision. March, 1912. (Case II.)



Longitudinal section showing central ivory-like bone, March, 1912. (Case II.)

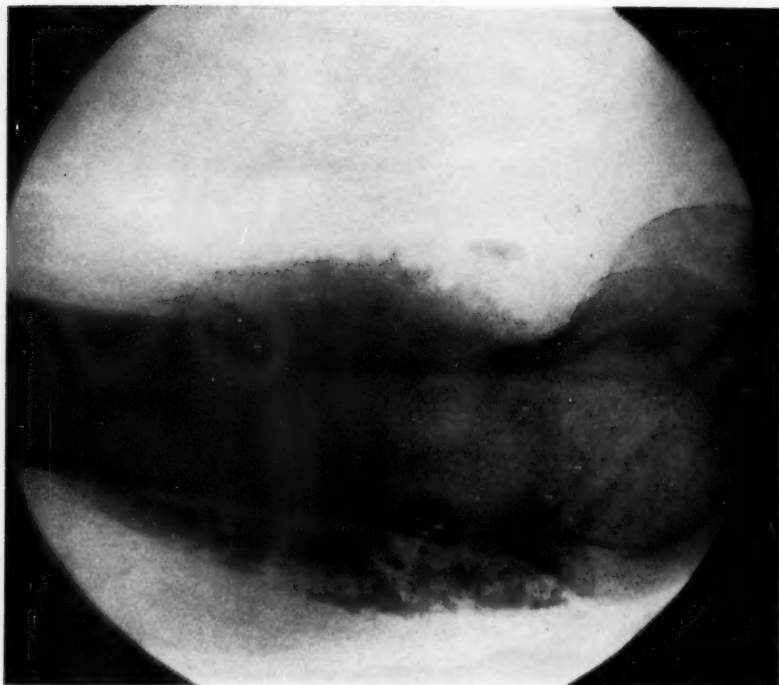


Myositis ossificans. May, 1909. (Case II.)



Myositis ossificans having become sarcoma. March, 1912. (Case II.)

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Myositis ossificans. May, 1909. (Case II.)



Myositis ossificans having become sarcoma. March, 1912. (Case II.)

ing over the central area. In other words, the character of the tumor had entirely changed, and the clinical appearance was absolutely typical of a rapidly growing sarcoma. The introduction of a needle drew only blood. The swelling had come on so suddenly and was so soft as to be almost fluctuating, that the possibility of an accumulation of blood or serum in the old cavity was considered though not regarded as probable. Under cocaine I immediately made a small incision and curetted $\frac{1}{2}$ oz. of soft grumous material, which, clinically, had every appearance of sarcoma. This was examined by Dr. Ewing and pronounced giant-celled sarcoma. His report reads as follows:

April 15, 1912: The sections of the myositis ossificans have been completed. They show areas of ordinary myositis ossificans grading into very cellular areas and finally into sarcoma of giant-cell type. There is no doubt that sarcoma is the final expression of the myositis process. As you know, these giant-cell sarcomas are not always very malignant, and I am inclined to think that this one is not, but as it occurs in a peculiar condition I would prefer not to offer any prognosis.

Dr. V. P. Gibney and Dr. Wm. A. Downes were called in consultation, and after careful deliberation it was decided best to try the effect of the toxins for 2-3 weeks before sacrificing the leg. The patient's general condition had greatly deteriorated within the last few weeks; she was extremely nervous and apprehensive, and unable to bear more than minute doses of the toxins, not sufficient to cause any marked reactions. As there was no retardation of growth noticeable at the end of two weeks, it was decided to amputate. Accordingly, on April 22, 1912, I amputated the leg 5 inches below the trochanter. The wound healed by primary union, but the patient recovered her strength very slowly. It was intended to continue the toxins as a prophylactic against recurrence after the wound had healed, but her general condition was so poor that it was considered unwise to do so.

It should be mentioned that for a number of years she had had enlarged glands in both cervical regions; these glands increased somewhat in size during the last year, but whether they represent metastatic growths or are the result of an old tuberculous process it is impossible at present to say. During November she developed very severe sciatic pains and pain in pelvis and back, accompanied by gradual loss of strength. She contin-

ued to grow worse and at present there is no doubt that she is suffering from metastases.

NOTE.—She failed rapidly and died January 12, 1913. A letter from her physician, Dr. Carleton B. McCulloch, stated that she had undoubtedly metastases in the lumbar and dorsal vertebræ.

CASE III.—*Myositis ossificans of the quadriceps extensor muscle*.—C. H., 16 years of age. Patient had always been well until the beginning of November, 1912, when, while playing football he received a severe blow in the left quadriceps muscle, which knocked him down. He did not notice anything until the next day when he found the leg very stiff and swollen, being one inch larger in circumference than the right; he could not bend the knee at all; there was no ecchymosis. Patient was referred to me by Dr. B. H. Whitbeck. Physical examination, December 19, 1912, shows a hard, bony swelling, fusiform in shape, occupying the anterior and middle portion of the left femur, most protuberant in its central portion, firmly fixed, measuring eight inches in length. The skin is normal in appearance and not adherent; motion at the knee is very greatly limited, extension normal, flexion very slight, not over 15° – 20° . The bony tumor seems to lie just beneath the skin and apparently involves the quadriceps muscle. Measurement over the most protuberant part of thigh, left: $17\frac{1}{2}$ in.; right: $16\frac{3}{8}$ in. There is no pain; walk somewhat unstable, the leg occasionally giving way; general health good. Examination of the X-ray photograph taken six weeks after the injury shows a fusiform tumor, apparently projecting about one inch beyond the periosteal border. The outline of the periosteum is distinctly marked; there are no indentations as ordinarily observed in sarcoma. In other words, the picture is almost identically the same as that shown in Case I. The photograph was taken by Dr. Byron C. Darling.

NOTE.—This case was observed the week following the reading of my paper and was kindly referred to me by Dr. Whitbeck, who made the diagnosis, having noticed its striking similarity to my cases just reported at the Surgical Society.

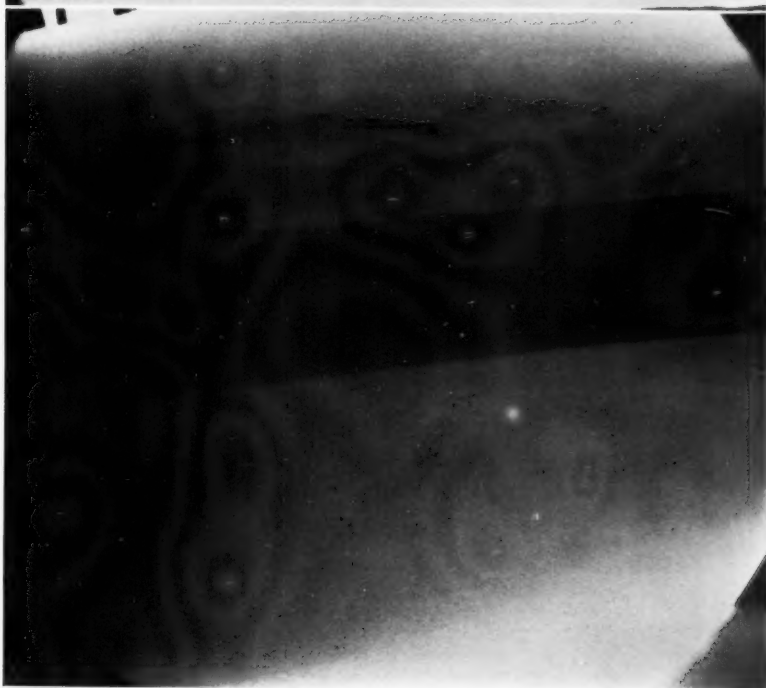
A careful study of 120 cases of sarcoma of the long bones, personally observed, has led me to the following conclusion:

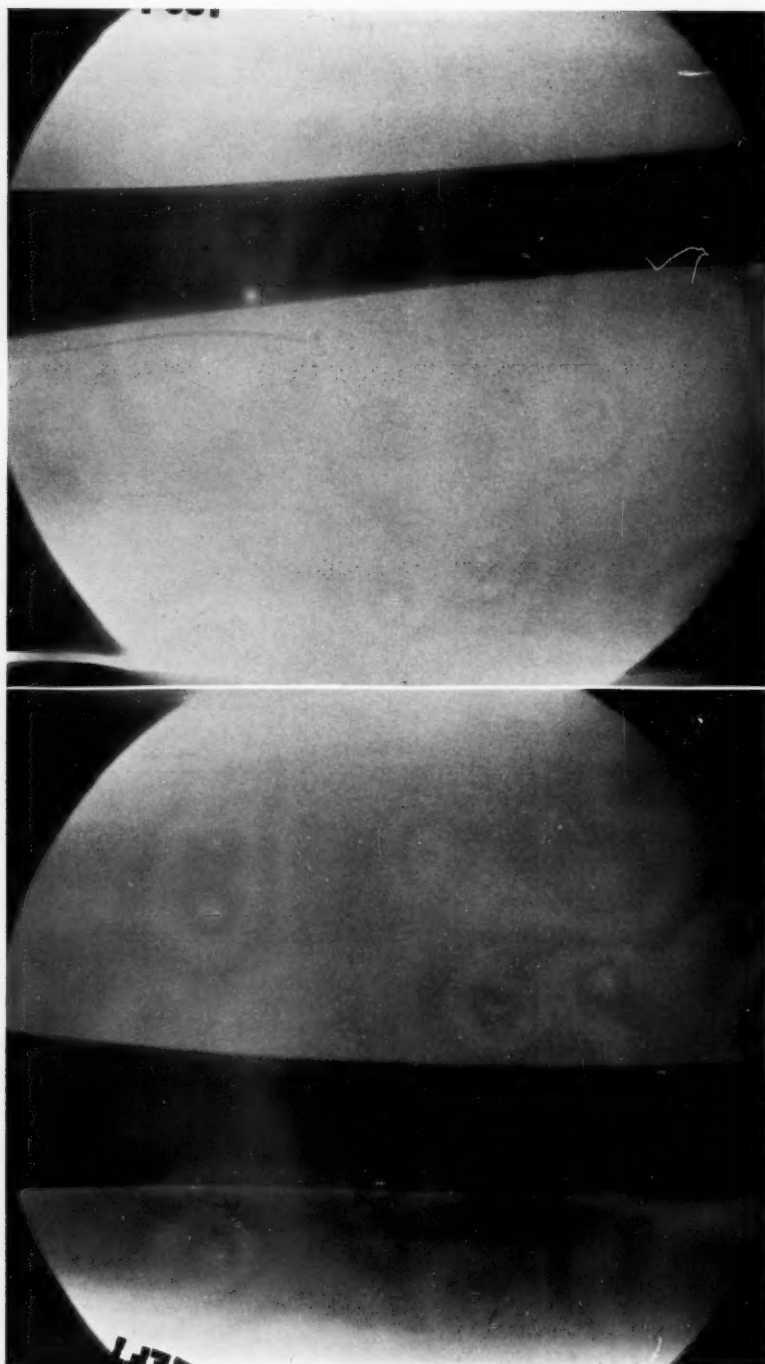
The diagnosis of sarcoma of the long bones in the majority

Sound femur (lat.-int. view). (Case III.)



Myositis ossificans, 6 weeks after injury (lat.-int. view). (Case III.)





Myositis ossificans. (Case III.)

Sound leg. (Case III.)

of cases can be correctly made from a careful clinical history of the case; a thorough clinical examination combined, if possible, with a good radiograph. In most cases it is wiser to do an exploratory operation and remove enough of the tumor for microscopical examination, in order to render the diagnosis beyond question. This is important—no matter what form of treatment be advocated. If the toxins of erysipelas and *Bacillus prodigiosus* are to be used before operation in the hope of avoiding an amputation, it is important that the nature of the tumor be settled beyond doubt, as it would be unwise to subject the patient to a long and none too agreeable course of toxin treatment if the disease were not sarcoma; and if it is sarcoma, and the patient recovers without the sacrifice of the limb, the value of the case from a scientific point of view is greatly enhanced if the diagnosis has been further confirmed by a microscopical examination. If amputation or even resection be the treatment decided upon, there is still stronger reason for having the diagnosis previously confirmed by microscopical examination.

Many objections have been raised against the wisdom of exploratory operations in malignant tumors in general, and particularly in sarcoma of the long bones. These objections have greater weight with English surgeons than with American. Some of these objections it must be granted are well taken, *e.g.*:

(1) The exploratory operation itself may cause grave risk, setting free, tumor cells in the circulation, thereby favoring general metastasis. While this result may possibly occur, long experience has shown it to be largely a theoretical objection rarely supported by clinical facts. A sufficient answer would be that the gain of having the diagnosis confirmed without question greatly outweighs the very slight and even problematical risk of general dissemination.

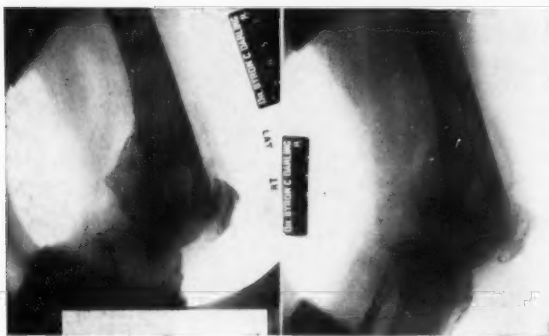
(2) Another objection and one that I think has more weight is, that the exploratory operation is often a very difficult one, especially in sarcoma of the lower end of the femur, particularly if situated posteriorly in the neighborhood

of the popliteal vessels. I have seen serious hemorrhages in several such cases, and in two cases found it very difficult to control them. However there is another objection which I consider of greater importance, and that is:

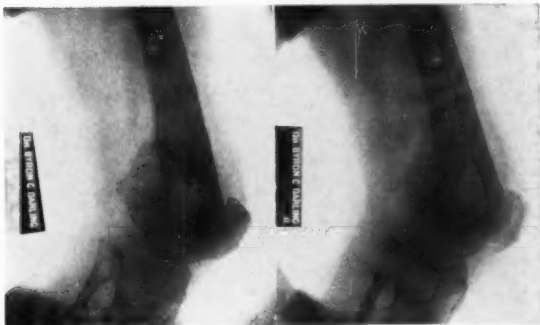
(3) The danger that such a deep wound may never heal; and if it does not heal it almost inevitably becomes infected, and the lack of good drainage may cause such severe septic intoxication, that amputation may have to be performed.

I will here cite two cases which well illustrate the dangers from exploratory operation in not easily accessible regions:

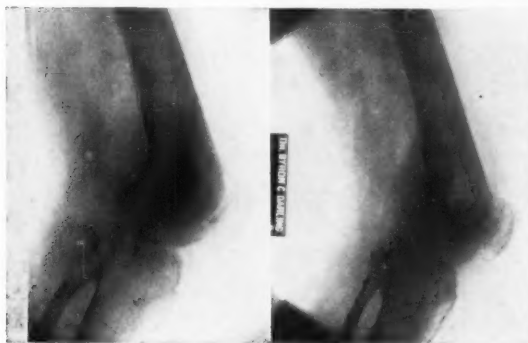
CASE IV.—*Central sarcoma of the femur, giant-celled type.*—A. J. M. C., male, aged forty-one years. Family history negative. Previous personal history unimportant. States that he had some pain in the knee in October, 1909. November 1 stumbled while going upstairs and injured right knee, which immediately became badly swollen and caused a good deal of pain; was treated as acute synovitis; unable to walk for a day or two. Under electrical treatment and massage for two weeks there was marked improvement, and he was able to walk without a cane. The swelling, however, never disappeared. In the spring of 1910, at the Massachusetts General Hospital he was operated upon, a 3½-inch exploratory incision over the internal aspect of the patella being made. No disease was found. Two days later an incision was made over the outer side of the patella and a tumor was found occupying the lower portion of the outer condyle. The wound was packed with iodoform gauze and bismuth paste; a sinus remained which never closed. His general condition remained good. The mixed toxins were started immediately after the operation. His weight increased from 190 pounds to 203 pounds. The first six injections with the toxins caused no reaction; the seventh produced a severe chill, followed by a temperature of 104°. After twelve injections, he returned home and had the treatment continued there. Two months later an X-ray plate was taken and as there was apparently some increase in size, amputation was strongly advised. Six weeks after this two other X-rays were taken and again amputation was strongly urged. The patient was brought to me by his brother, who is a physician, on January 23, 1911.



Interval, 3 months—March, 1911—June, 1911. Central sarcoma of femur controlled by the mixed toxins for nearly one year, *vid. text.* (Case IV.)



Interval, 6 months—March, 1911—September, 1911. (Case IV.)



Interval, 1 year 2 months—January, 1910—March, 1911. (Case IV.)

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Examination at this time showed very slight enlargement of the lower end of the femur, chiefly in the region of the knee-joint; there was slight fluctuation in the joint and some redness of the skin. There was a scar about $3\frac{1}{2}$ inches long on the inner side of the knee, and an unhealthy looking sinus above the joint from which there was a profuse discharge of pus of a greenish tinge. There was a small enlargement of the lower end of the femur itself, most marked over the outer condyle. Measurements 9 inches above the patella are the same on both sides, showing that there is no atrophy of the muscles. I had an X-ray photograph made at this time, which, compared with the earlier photographs, showed little if any increase in size. In view of the previous diagnosis of sarcoma of the giant-celled type, it seemed to me unwise to amputate the leg without a more thorough trial with the toxins. The patient was sent to the General Memorial Hospital and a few days later, in order to establish better drainage, I made an incision over the old sinus and curetted out a considerable amount of tumor tissue, mixed with pus and bismuth paste. Microscopical examination showed it to be sarcoma of the giant-celled type. I found it extremely difficult to control the hemorrhage, and only succeeded by introducing gauze packing very tightly. A very severe attack of toxæmia followed, with a temperature of 104° – 105° . The patient was in a serious condition for two or three days. On recovering from this, I at once put him on the mixed toxins, beginning in small doses, and gradually working up to the point of getting a reaction of 102° – 103° . The wound was drained with a large tube. After a short time the patient's condition became normal; he was sent home and the treatment continued by his brother, with occasional intervals of rest. During the treatment, X-ray photographs were taken every four or five weeks to determine whether or not there was any increase in the growth; none could be made out and there was apparently a decrease of tumor tissue with substitution of normal bone (vid. illustration).

The patient's general health remained perfect in every way; he weighed more than he ever did; he went about comfortably with a cane; the sinus remained open, however. In the beginning of January, 1912, after about one year's treatment, a portion of the rubber tube became broken off in the wound, causing infection of the sinus followed by a severe attack of toxæmia.

His condition became so serious that in the mind of Dr. C. A. Porter of Boston and the other physicians attending him, it seemed necessary to amputate the leg in order to save his life. Examination of the tumor after operation showed little or no increase had taken place during the year of treatment.

I am just in receipt of a letter from Dr. C. A. McCarthy, the patient's brother, who states:

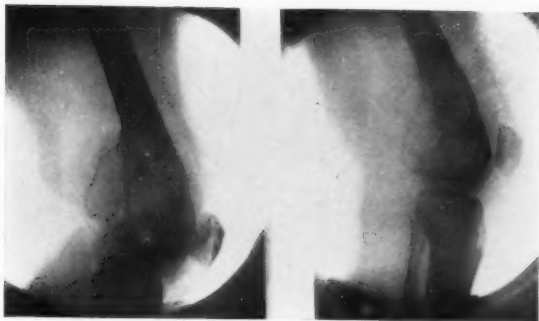
"My brother's health is excellent; he has an artificial limb and walks splendidly."

Specimen was examined by Dr. J. H. Wright, whose report reads:

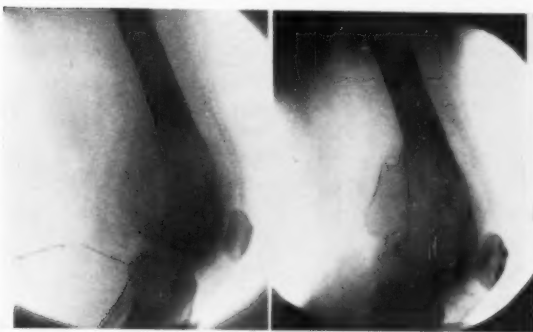
"Specimen consists of the lower half of the femur and some other adjacent parts. In the epiphysis is an irregular-shaped cavity of about the total volume of a small hen's egg. Partially bounding this cavity is a layer of white fibrous-like tissue 1 or more cm. thick in places, and attached to the cortical bone, and to the bone underlying the joint surface. At the upper extremity of the cavity and replacing the marrow of the shaft of the bone for a length of 3 or 4 cm. is a red, moderately firm tissue. This tissue is rather sharply demarcated from the layer of white fibrous-like tissue above described. Microscopical examination of sections from this red tissue shows a typical giant-cell sarcoma."

At almost the same time, another patient of about the same age, with exactly the same type of tumor, also in the right leg, came under my care:

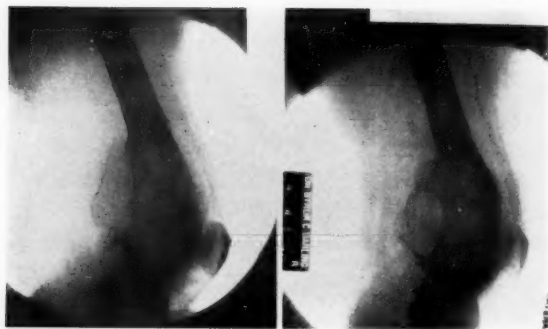
CASE V.—*Central sarcoma of the femur, giant-celled type.*—G. H. S., male, aged forty-seven years, resident of Detroit, Michigan. Family history negative. Personal history: three years before in the beginning of 1908, had fallen upon the ice injuring the lower end of the right femur. An X-ray was taken, and the bone was said to have been cracked. The condition was called by the surgeon a dislocation of the knee. One year later he had another fall; again the knee was said to have been dislocated. In February, 1910, he had a third fall, injuring the same knee. The swelling which had appeared shortly after the first injury had never subsided, and after the third injury began to increase rapidly in size. The series of X-rays taken within the preceding six months showed marked diminution in density of the lower three inches of the right femur and expansion of



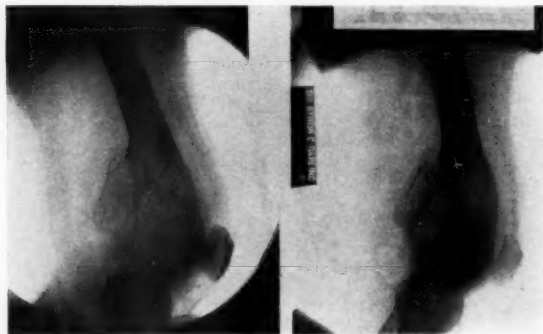
Interval, 3 months—December, 1910–February, 1911. Central sarcoma of femur controlled by toxins for nearly one year, *vid.* text. (Case V.)



Interval, 1 month—February, 1911–March, 1911. (Case V.)



Interval, 4 months—February, 1911-June, 1911. (Case V.)



Interval, 1 year 1 month—February, 1911-March, 1912.
(Case V.)

the femur, with a sharply outlined, tumor-like formation, projecting about an inch beyond the normal outline of the bone. The tumor occupied chiefly the posterior or popliteal region of the femur, although the bone was enlarged in all directions; the joint was not involved. Various diagnoses had been made by a number of leading surgeons and X-ray experts. Nearly every one had given a different diagnosis. One of the most prominent surgeons of Chicago, who had seen it, believed it to be a cyst of the bone, non-malignant; another believed it malignant and advised amputation. My own diagnosis was, that it was unquestionably a sarcoma of central origin, probably giant-celled. On February 23, under ether anæsthesia, an incision six inches long was made over the inner condyle of the right femur, cutting down to the periosteum, pushing the vessels to one side in order to explore the popliteal region. A tumor about the size of a goose egg, apparently situated beneath the periosteum, was found. On opening this and passing through a thin shell of bone, a mass of partly broken-down, soft material was encountered, reddish-gray in color, and having the appearance of a vascular sarcoma; the finger passed into the cavity of the bone; the joint was not involved. Here again there was severe hemorrhage which it was found difficult to control. It was finally stopped by packing, as in the preceding case. Microscopical examination showed the tumor to be a sarcoma of the giant-celled type. The patient was immediately put upon the mixed toxins and remained under my care for two months, after which the treatment was carried out by Dr. J. W. Vaughan, of Detroit. The patient proved to be extremely susceptible to the toxins and was unable to take more than 3-4 minims, which were followed by severe reactions, the temperature rising in some instances, to 105°-106°. At the end of four months' treatment his susceptibility had increased instead of diminished and he was unable to take more than 1-2 minims.

In this case, as in the preceding, a series of X-ray examinations were made every four or five weeks, and these were carefully compared with the pictures taken before the operation. Physical examination July 27, 1911, showed much less discharge from the sinus, which has persisted since the operation. Measurements over the middle of the patella showed a decrease of one inch, from 18½ before operation to 17½ now. January 5, 1912, I again examined the patient, and found his condition better than

at any time I had seen him; his weight had increased from 192 pounds in February, 1911, to 219 pounds. At this time the discharge had become very much diminished. The X-ray photograph taken the day before showed apparent diminution in size of the tumor with replacement of new bone; no extension of the disease could be made out in any direction; ability to use the leg better than before; general health perfect. The toxins were kept up in moderate doses, with occasional intervals of rest. In February, 1912, suddenly, while walking without any unusual exertion, spontaneous fracture occurred, with very profuse extravasation of blood into the surrounding soft parts, requiring almost immediate amputation. The patient recovered from the operation.

It might be concluded from these two cases that the use of the toxins preliminary to the amputation was an unwise procedure. Yet before forming an opinion one should consider the fact that there are now on record a comparatively large number of cases of sarcoma of the long bones, in which the use of the toxins has not only saved the life of the patient but the limb as well. I myself have had 9 patients, 4 of which I showed before the Clinical Congress of Surgeons of North America, November 14, 1912, well from five to fourteen years.

I believe had it not been for the exploratory incision and the consequent infection, that in all probability the sarcomatous disease would have been entirely controlled by the toxins, and the leg thereby, in one case at least, saved from an amputation. The X-ray photograph and subsequent operation by Dr. Porter in one case showed little if any increase in the size of the tumor during the year or more in which the toxins were used, and the general health of the patients remained perfect. Had the toxins not been used at all, amputation would have been performed $1\frac{1}{2}$ years earlier. I feel that had one been satisfied in these two cases with the probable diagnosis, instead of insisting upon an exploratory operation and microscopical examination, the patients' welfare, which should always be the primary consideration, would doubtless have been better served. Were I

again called upon, in a similar case, to decide the question of an exploratory operation, I am inclined to believe that I would not advise an exploration in a sarcoma so deeply situated and so difficult of access, in view of the dangers just described. I would trust to the clinical diagnosis confirmed by the X-ray examination and try the toxins for a brief period before amputation, and if no improvement was noted at the end of two to three weeks then decide upon an amputation or resection.

As a general rule I would not amputate a limb for sarcoma unless the clinical diagnosis had previously been confirmed by exploratory operation and a microscopical examination. Yet, there are important exceptions to this rule. I have amputated an arm at the shoulder-joint without any exploratory operation for a tumor the size of a closed fist, that had developed in three weeks. The dilated veins, general appearance and consistence of the tumor made me certain of the diagnosis. I have also amputated the leg for a very large sarcoma of the tibia and fibula; again, for a large sarcoma of the fibula. In addition I have twice performed total excision of the clavicle for sarcoma without previous microscopical examination to confirm the diagnosis. In all of these instances, the very rapid development of the tumor after trauma (within three weeks in three instances) and the clinical features characteristic of sarcoma, made the diagnosis absolutely clear. In these cases the dangers and disadvantages far outweighed the advantages of an exploratory operation, and justified immediate amputation without a microscopical diagnosis.

(4) Still another objection, and a very strong one, is that the tissues removed at the exploratory operation may not represent the typical structure of the tumor and, therefore, lead to a negative report on the part of the pathologists. The incision may not have been sufficiently deep and the portion removed may show evidence only of osteitis or productive inflammation, and the pathologist must give a negative report. In the face of such negative report, the surgeon feels it difficult

to determine the best course of action. The situation is well illustrated by the following case recently observed by the writer:

CASE VI.—Mrs. G. M., twenty-seven years of age; in May, 1912, first noticed pain in leg, which was treated for rheumatism for two months, without improvement. There was 14 pounds loss in weight. An X-ray was taken and on basis of same a diagnosis of periosteal sarcoma was made and immediate amputation was strongly urged, without any further examination. The patient was two months' pregnant, and in preparing for the amputation the uterus was emptied. Her husband was told that there was no possible alternative to amputation. The patient was referred to me on September 19, 1912. Examination at this time showed a hard, fusiform enlargement 7 by 8 inches in length, apparently of bony origin in the upper and middle thirds of the femur, gradually shading off into the normal outline of the bone. Largest circumference $19\frac{1}{2}$ inches; skin normal; no enlarged veins.

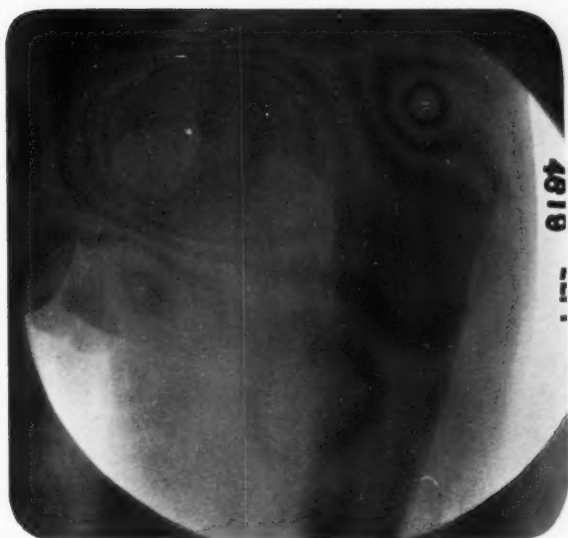
The patient entered the General Memorial Hospital and was put upon the mixed toxins. Wassermann examination of the blood proved negative. At the end of a week I made an exploratory incision in about the middle of the tumor, and on cutting down found a fusiform enlargement of the femur of the consistence of a periosteal sarcoma. The tumor extended about $\frac{1}{2}$ inch beyond the normal line of the bone. A wedge-shaped portion was removed; there was no trace of any inflammatory exudate and no infiltration of the surrounding tissues. Clinically it had the typical appearance of a periosteal sarcoma, originating in the shaft of the bone, and the consistence and gross appearance of the specimen confirmed this view. The specimen was sent to Dr. Ewing, who reported as follows:

September 28, 1912: The tissue shows very little if any specific process and does not permit of a diagnosis. There is infiltration of the vessels with large round cells, suggesting sarcoma, but which might very well be tuberculous. I ought not to express any opinion on the data received and I would not amputate without further information.

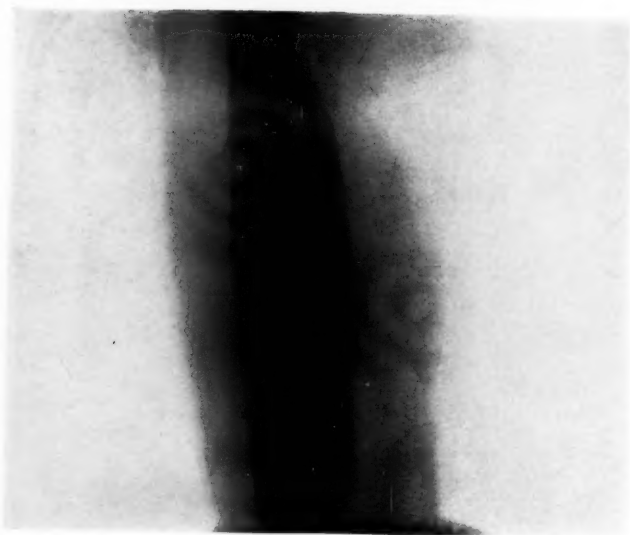
On entrance to the hospital, the measurements over the upper, middle, and lower part of the cicatrix, representing the upper, middle, and lower end of the original tumor, were as follows:



Periosteal sarcoma of femur (clinical diagnosis), 2 months later. (Case VI.)



Sarcoma of femur mistaken for osteomyelitis. Death from lung metastasis three months later.



Periosteal sarcoma of femur (clinical diagnosis). (Case VI.)



Periosteal sarcoma of humerus—site of recent fracture. (June, 1910.) (Case VII.)



Sarcoma of humerus developing at site of recent fracture. Partial disappearance under toxin treatment. Interval, 5 months—July, 1910–December, 1910. Recurred December, 1910. Amputation shoulder-joint. Large recurrent tumor removed from pectoral region few months later. Patient in perfect health, February, 1913, nearly two years later. (Case VII.)



Osteoma of humerus. Differs both from sarcoma and myositis ossificans. (Case VIII.)



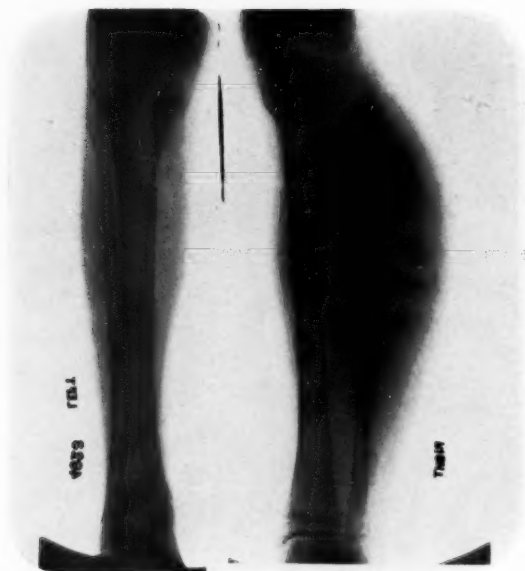
Osteomyelitis, humerus. Normal humerus. (Case IX.)



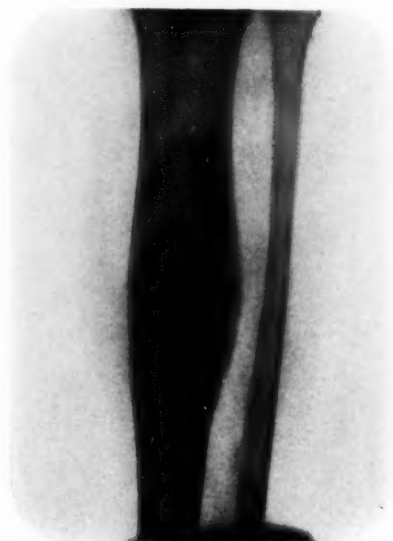
Sarcoma of fibula, periosteal. (Case X.)



Sarcoma of fibula, periosteal. (Case X.)



Sarcoma of fibula (amputation). Without preliminary microscopic examination. (Case XI.)



Osteitis, non-malignant. Exploratory operation. (Case XII.)



a *b*
a, bone cyst of tibia; *b*, normal tibia. (Case XIII.)



Periosteal sarcoma of femur. (Case XIV.)



Sarcoma of femur, periosteal. (Case XV.)



Sarcoma of radius, amputation 8 years ago. Toxin treatment after operation. Permanent cure. (Case XVI.)



Normal for comparison Cured by the mixed toxins of erysipelas and B. prodigiosus without amputation. (Case XVII.)



Sarcoma of radius.

Right, 16 in.; $18\frac{1}{2}$ in.; $19\frac{1}{2}$ in. Left, $15\frac{1}{2}$ in.; $17\frac{1}{2}$ in.; $18\frac{1}{4}$ in.

November 7, right, $14\frac{1}{2}$ in.; $16\frac{1}{2}$ in.; $17\frac{3}{4}$ in. Left, $14\frac{1}{2}$ in.; $16\frac{3}{4}$ in.; 18 in.

November 26, right, $14\frac{3}{4}$ in.; $16\frac{3}{4}$ in.; $18\frac{1}{4}$ in.

The toxins were continued four to five times a week and the dose gradually increased from 0.5 minim to 6 minims. At the end of two weeks there was marked diminution in the circumference of the thigh. In view of the lack of certainty of Dr. Ewing's diagnosis and the rapid improvement under the toxin treatment, it was deemed very important to make a second exploratory incision, and on November 1 I made another incision $\frac{1}{2}$ inch away from the first, 5 inches in length, and cut down upon the tumor. The latter was found considerably smaller in size, projecting only about $\frac{1}{4}$ inch from the shaft of the bone. An opening was chiseled into the central portion of the bone and several pieces of periosteal as well as central growth were removed and sent to Dr. Ewing. Clinically the tumor had every appearance of a partially necrotic sarcoma, a condition frequently seen as a result of the use of the toxins. Three X-ray photographs have been taken since by Drs. L. G. Cole and Holding, who believed the condition to be periosteal sarcoma. Dr. Ewing's report of the last specimen, dated November 1, 1912, reads:

Five sections from five different parts of the tissue received fail to show any signs of sarcoma. There is suppurative inflammation in an area lined with granulation tissue. The periosteum and bone show an active productive and rarefying osteitis. I find no signs of syphilis or tubercle. The condition suggests to me a pyogenic infection of the periosteum or osteomyelitis.

The clinical history and macroscopic appearance at the time of operation make it impossible to regard it as an osteomyelitis.

Subsequent History.—The tumor slowly subsided under the toxin treatment and at the end of six weeks the circumference of the thigh became nearly normal. The patient has had the toxins continued at home for the reason I did not believe it wise to place too implicit faith in a negative pathological report from small portions of material removed at an exploratory operation. She has gained 10 pounds in weight.

January 6, 1912, examination shows the tumor has been in-

creasing in size the last three weeks, but the general health is still good. I still believe the condition to be periosteal sarcoma.

NOTE.—February 16, 1913. Under larger and more frequent doses of the toxins the tumor is again decreasing in size.

Though we may never know the exact nature of the tumor in question, the conditions show very clearly the difficulties of diagnosis as well as of treatment. This case might be cited to prove the wisdom of not amputating a limb for sarcoma except the diagnosis be established beyond question.

On the other hand the case (Case II) that furnished the inspiration for the present paper, already described at length, might be said to prove the opposite contention, viz., that it would be wiser to operate on the clinical diagnosis alone, even in the face of a negative report of the pathologist. In said case we have a tumor of the femur of 2½ years' duration, pronounced by a number of experienced clinicians as positively sarcoma, and an equal number of X-ray experts confirm this diagnosis. Believing it a possible case of myositis ossificans, I advised an exploratory operation, reserving the method of treatment to be decided by the result of the microscopical examination. The macroscopical appearance of the material removed was perfectly characteristic of new bone, in no way resembling sarcoma. The report of the pathologist was myositis ossificans, no trace of sarcoma. Two and a half years later, as shown by the history given, there seemed to be a slight increase in the size of the original tumor, which was confirmed by the X-ray. A second exploratory operation was determined upon and a much more extensive removal of the growth was made for microscopical examination. Again the structures showed myositis ossificans, and again on the strength of the report I refrained from a more radical operation, which later events proved would have been the wiser plan.

There are two theories which may be advanced in explanation of this most obscure case: First, that we were dealing with an original traumatic myositis ossificans which, after several years, degenerated and changed into an osteosarcoma.

In support of this theory may be cited the well-known fact that not infrequently benign tumors of the breast, cysts, cystadenomas or fibromas, do undergo malignant degeneration and become carcinoma. Likewise do chronic inflammatory conditions often undergo similar degeneration in course of time. Old fractures offer favorable sites for the development of sarcomata.

The second view is that soon after the accident a sarcoma developed in the bruised and strained portion of the periosteum, the sarcoma remaining of very slow growth and almost latent for nearly six years, and then suddenly, and possibly aggravated by the trauma of the second exploratory operation, lighted up and grew with great rapidity.

Dr. Ewing accepts the latter view as the true one, and believes that the careful microscopical examination gives evidence of its correctness.

I incline to believe the first view, namely, that the sarcoma was of comparatively recent origin, developing from the site of an old myositis ossificans, to be more in accord with the clinical history and known facts. If the tumor was sarcoma from the first, then it was sarcoma at the time of my first exploratory operation, nearly three years later. The specimen removed was not superficial, but extended down fully an inch into the growth and was carefully removed with a chisel. Clinically it had every appearance of new bone; it was absolutely unlike sarcomatous tissue. Microscopical examination by Dr. Ewing himself failed to show any trace of sarcoma. Again, $2\frac{1}{2}$ years later, the clinical appearance was the same, except for the very slight increase in size. The second exploration was far more extensive than the first, and a large amount of the growth covering an area of 3 inches in circumference and $1\frac{1}{2}$ inches in depth was chiseled and cut away. This material was macroscopically precisely the same as at the first operation, and was again regarded as myositis ossificans by Dr. Ewing. It is true, there were some cells of peculiar type found at the second operation which he could not fully explain, and which in the light of later evidence were probably cells beginning to undergo sarcomatous

changes. The complete and rapid change in the clinical appearance of the tumor two months later would seem to show a corresponding change in its real nature. This was further confirmed by the microscopical examination of the tissues removed at this time.

If we accept Dr. Ewing's view, and his opinion is entitled to more weight than my own, we are forced to the unwelcome conclusion that we can place very little reliance upon the pathologist's report of a specimen removed by an exploratory operation in tumors of the long bones.

In my first case, the negative report of the pathologist saved the patient from an amputation which otherwise would have been performed. In the second case, the negative report prevented an amputation which would otherwise have been done three years ago, with a greater prospect of saving the life of the patient. No matter how we interpret these two cases, we are forced to conclude that the diagnosis of tumors of the long bones is extremely difficult and in certain cases, though happily rare, it may be impossible, even with the advantage of every known aid, to make a diagnosis early enough to save the life of the patient.

The only type of sarcoma which could simulate the condition found on amputation, is the type designated by Gross as osteoid sarcoma, and it must be admitted that there is some similarity. He describes one case in which the ossified portion of the growth proved a huge mass which looked like spongy bone, and another, in which the appearance was that of dense ivory-like bone. Yet, the history of these very cases cited by Gross, makes it difficult to accept Ewing's theory that the case in question was sarcoma from the beginning. Gross collected 45 cases of the osteoid type of sarcoma, and from a study of these cases, he concludes that "not only are osteoid sarcomas locally infectious, but they are next to the pure periosteal spindle-celled, the most malignant of all the neoplasms of the osseous system, since 65.62 per cent. of all cases died of metastasis." In other words, this type of tumor is extremely malignant, and that means a short duration of

life. In fact, in the seven cases which ended in death, without surgical interference, the average duration of life was 16 months, so that it would seem extremely improbable that the tumor in my own case—which had existed for nearly six years before it began to affect the general health of the patient—should have been of this type. Furthermore, in my own experience, based upon a personal observation of 125 cases of sarcoma of the long bones, I have never seen a case of six years' duration, or even three years' duration, without operation.

MYOSITIS OSSIFICANS.—There are three well-recognized types of myositis ossificans which have been described from time to time and which have been receiving more and more attention since the introduction of the X-ray made it possible to study them more accurately.

The first type, known as myositis ossificans progressiva, goes on involving one muscle or group of muscles after another until all the muscles of the body are involved. It usually starts in the trapezius muscle or latissimus dorsi.

The second type is single instead of multiple, and is the result of some chronic irritation or of a series of traumas, instead of a single trauma, well illustrated by the simple osseous formation that occurs in certain muscles so situated as to be liable to irritation or injury, *e.g.*, the pectoral muscle in soldiers, as a result of the kicking of the musket. (Hassen found 18 osteomas in 600 conscripts.) Again, this type is found in the muscles of the calf of the leg in cavalrymen and the heel of dancers.

The third and rarer variety is the one with which we are dealing in the present paper, and one seldom recognized before the admirable papers of Binnie (*ANNALS OF SURG.*, Sept., 1903) and Robert Jones (*Arch. of the Röntgen Ray and Allied Phenomena*, 1905–1906). Binnie reported a most interesting personal case and collected all the other cases he was able to find in the literature up to that time. Cahier (*Rev. de Chir.*, 1904) collected 257 cases of myositis ossificans

traumatica, including the second and third varieties, but not the progressive type.

Most statistics, up to the time of Strauss, grouped together, under the general head of myositis ossificans traumatica three or four different conditions. The term should properly apply only to those resulting from a single trauma. It is interesting to know that Strauss collected 127 such cases. Of these 43 occurred in the quadriceps femoris, 13 in the adductors of the thigh, 64 in the flexors of the upper arm; the remainder were scattered over various muscles of the body. The best papers in recent years are that of Finney (*Transaction of the Southern Surgical Society*, 1909), and that of Lapointe (*Revue de Chirurgie*, Nov., 1912).

Finney reported six cases, three observed by himself, three others seen in consultation, four occurred in football players; one came to operation; all recovered.

To emphasize the point which I shall discuss more fully later, that the disease may closely simulate sarcoma, it is stated that the diagnosis of subperiosteal sarcoma had been made in all three of Finney's cases. One case, operated upon twice, recurred, necessitating three operations. Amputation at the hip-joint had been recommended and was about to be performed in one case, when first seen by Finney. In another case quoted by Finney (Whitelock) amputation of the thigh was performed under the mistaken idea that the condition was a periosteal sarcoma.

Finney states that males are almost invariably the subjects of this affection, only two cases in woman having been thus far reported. This is probably explained by the fact that men are much more liable to severe injuries, which are the exciting causes. The disease is much more common since the introduction of football. Of Finney's cases two were due to the kick of a horse, four to injuries received while playing football.

The most recent and elaborate study of the pathology and treatment of myositis ossificans, or "myostéomes traumatiques" as the French characterizes the disease, is that of

Lapointe, published in the *Rev. de Chir.*, in November, 1912. Lapointe reports one case of his own, of the quadriceps extensor, very closely resembling my own cases and that of Mr. Makins. This case occurred in a man twenty-one years of age who attributed the trouble to a fall three weeks before. A tumor apparently springing from the anterior and middle portion of the femur, 17 cm. in length, had developed within the short period of 24 days after the injury. Extension was normal, flexion markedly limited. An interesting feature which I have not noted in other cases, was a temperature of 99° – 100° . Lapointe states that he made a grave error in diagnosis. The very close fusion with the diaphysis of the femur, the slight dilatation of the superficial veins, the temperature, all seemed typical of a periosteal sarcoma. The radiograph which should have corrected the error only emphasized it by reason of the use of an imperfect plate. The radiographer took a second plate which gave an identical result. Before proposing to the patient such a mutilating operation as amputation at the hip-joint, he decided to wait a short time. In 15 days the supposed sarcoma, instead of increasing in size, had diminished. Another radiograph, taken a month later, showed the same characteristic appearance of myositis ossificans as I have observed in my own cases. Lapointe operated on May 26, 1911, 66 days after the injury, and removed an elliptiform tumor $17 \times 5 \times 3$ cm. Muscular fibres completely surrounded it except at its point of attachment to the femur over an area 6 cm. long and 2 cm. broad. A fragment of periosteum detached from the femur adhered to the internal aspect of the osteoma. The patient made a good recovery, but had a slight recurrence four months later.

Robert Jones, in 1905, gave a brief history of 15 cases of the third variety personally observed, and a résumé of most of the cases collected by Cahier and Binnie. Most of Jones's cases occurred in the vicinity of joints. In only two of Jones's cases was there a microscopical examination made and the pathologist's report (Dr. Dimond, hospital pathologist) reads as follows: "In the first case the bone generally is of

the cancellous type and at the edge of the bone the muscle seems to have been sprinkled with numerous small foci, around which the bony matter has been deposited; generally the centre of these foci contains a small branched cell (osteoblast). The bony matter is deposited along the muscle-fibres and at parts of the specimen the striation of the muscle is still visible. The condition is a true ossification, not calcification."

In the second case he reports: "The general shape of the bone was that of a V. There were no signs of any periosteum whatsoever. There were numerous foramina over the whole bone, into many of which passed small tendinous extensions from the surrounding muscle, and into others passed small blood-vessels which communicated directly with the cancellous spaces throughout the mass of bone. The general structure was that of soft or cancellous bone, the spaces being fairly large and occupied by blood-corpuscles and a few giant-cells, etc."

These two cases show a structure strikingly similar, both macroscopically and microscopically, to that observed in my own two cases. The clinical history in Jones's and the collected cases was much the same. We have the history of an antecedent blow or injury and the subsequent development of a hard tumor a few weeks or months, or in some cases years, thereafter.

In none of the cases thus far reported has there been a history of transformation or degeneration of the bony tumor into a sarcoma or malignant growth. Yet it would be impossible to state that such a result never occurred in these cases, inasmuch as they are nearly all lacking in the very important detail of after-history. Makins' two cases published in the *Transactions of the Royal Soc. of Med., Surg. Section*, 1911, are an important exception. In both cases an X-ray was shown of the original condition and the condition six years later.

Etiology.—The question of the etiology of traumatic myositis ossificans has already been fully discussed by Binnie

and Robert Jones, and therefore I will not go into it at length, but will merely mention the various theories propounded.

The first theory was, that the blood which extravasated at the time of the injury later became transformed into bone. Our increased knowledge of pathology has made such a theory untenable.

Another theory is that advanced by Cahn, and based upon the assumed correctness of Conheim's theory of tumor development. It presupposes aberrant embryonic cells in various parts of the body and has little to support it.

The third theory is that at the time of the injury, a portion of periosteum becomes detached and from these fragments of periosteum result the bone formations in the muscles and fascia. In other words, that they are in the nature of bone grafts.

Ziegler and other pathologists of more recent times believe that the process is one closely related to tumor formation.

Binnie states: "It will be noticed that in my case ossification is as far advanced in the distal as in the proximal portions, that around and throughout the tumor there is great proliferation of the intramuscular connective tissue, that ossification is both of the fibrous and cartilaginous type, and that muscle-fibres in every stage of degeneration are scattered here, there, and everywhere, lying in the connective tissue, in among the islands of cartilage, and hugged by the trabeculae of bone. There is no microscopical evidence of any inflammatory changes. If this case is one of purely periosteal origin, then the scattering of the periosteal cells or grafts must have been through a territory extraordinary in length and in latitude wonderfully limited. Its origin from a separated periosteal flap is simply inconceivable in view of its relations to the innumerable discrete and degenerating muscular fibres. From careful examination of even this one case, one is forced to admit the possibility and probability of the bone tumor being the result of proliferation and metamorphosis of the intramuscular connective tissue."

Robert Jones believes that in the majority of cases the

growth springs from the periosteum. He bases his conclusions "largely upon the frequency with which these growths are associated with dislocation; their frequent attachment to bone; their frequent growth between the bone and muscle, and sometimes their attachment below the muscle origin, which has been subjected to a violent strain; that in fractures shreds of periosteum may give rise to the development of bone apart from the callus and reparative processes." Jones states that in nine-tenths of the cases the tumor formation is marked in the first two months, the majority by the end of the first month. The recent researches of Macewen upon the growth of bone give rise to some doubt as to the periosteum's being the sole cause of the new bone.

After a very full discussion of the various theories as to the etiology of myositis ossificans, Lapointe states that in his opinion "the theory of an ossifying myosteoma is tenable both for the adhering myosteomas and for the free ones. It can be seen that the insertion into the skeleton is the only point which distinguishes them. All of their other characteristics, both microscopical and macroscopical, are the same. No difference in the method of their development or in their structure has ever been found. The cartilaginous ossificans that has been considered as a type of periosteal osteogenesis is found also in the medullary osteogenesis, so, why should we maintain that the tendinous insertion of a muscle, which is an incontestable factor in the formation of free myosteomas, has not to do with the formation of adherent myosteomas? Is the implantation or non-implantation enough to justify two different pathogenic theories?"

Gillet, in his Thesis of Paris (1910), discusses at some length the difference between myosteomas (myositis ossificans) and true neoplasms. He states the fact that the former not infrequently recur does not constitute them neoplasms, although some writers take the opposite view. A true neoplasm is capable of not only local return but of general metastases, a quality which the tumor in myositis ossificans

does not possess, there being no case on record so far of other than a local return.

He believes that whatever the anatomical considerations, clinically osteomas should never be classed as tumors, and states that, in the first place, we are able to reassure the patient and his family as regards any fears of a tumor. Whatever the variety of osteoma, it is always benign without tendency to increase indefinitely or to generalize, and never is transformed into a malignant process.

This statement of Gillet's was probably true at the time it was written, though the evidence here presented may lead to some qualification in the future.

Diagnosis.—Various conditions may simulate myositis ossificans, particularly in the early stages, *e.g.*, contusion, hæmatoma, myositis, periostitis, periarthritis, syphilitic tumors; but all of these conditions can be differentiated by means of a careful examination aided with a good radiograph.

In periostitis and osteomyelitis, we usually have elevation of temperature, local tenderness, severe pain which is worse at night. Myositis is prone to develop in certain muscles which are seldom the site of syphilitic disease, and the Wassermann test will furnish an additional aid in differentiating the conditions.

On the other hand, the age of the patients (usually young adults) and the fact that the tumor developed shortly after an injury furnish a history almost identical to that observed in sarcoma. In many cases, too, there is a striking similarity in the X-ray picture between the two diseases. In my first case, the X-ray plates had been examined by at least half a dozen X-ray experts and all pronounced the lesion sarcoma. Careful examination, however, of the radiographs which I have been able to observe personally shows this important difference:

In myositis ossificans the sharp outline, corresponding to the junction of the tumor with the bone, is always present, while in sarcoma it is less distinct except in the very early stages of the disease. It was this feature which influenced me

chiefly in making the diagnosis of myositis ossificans in the first case. In the second case the same clear line of differentiation is observed in the earlier picture, although it is not so distinct in the later. I have seen but one case of periosteal sarcoma in which this was not true, and this happened to be a case of extremely rapid growth, apparently sarcoma, in a young adult, a woman of nineteen. The X-ray photograph taken about a month after the beginning of the tumor showed a clear line without any roughness or indentations, which could easily be mistaken for myositis ossificans. In this case, however, there was the absence of a severe injury which is almost always the exciting cause in myositis ossificans, which furnished an important aid in making the diagnosis.

A further and very important point which I have not seen noted in other articles is the marked difference in the consistence of the tumors as determined by palpation. In myositis ossificans the consistence is much harder than in sarcoma; furthermore, it is almost always uniform in character, whereas in sarcoma it is very apt to be soft in some places and harder in others, but there is never the bony hardness that is typical of myositis ossificans.

The pain is another important differential symptom. In sarcoma there is rarely pain in the early stages, unless the tumor is situated near some important nerve, whereas in myositis ossificans pain is much more apt to be a feature in the early development of the disease. Furthermore, the early disability of the neighboring joint, as usually observed in myositis ossificans, has been seldom noted in sarcoma in the early stages. Flexion of the knee is almost lost or greatly limited, and this may occur very soon, a few days after the injury, in myositis ossificans.

The clinical history together with the characteristic features already enumerated will, in most cases, enable one to render a correct diagnosis of myositis ossificans; yet the great importance of making an early and absolutely certain differentiation from sarcoma, in my own opinion, justifies an early exploratory operation and removal of sufficient ma-

terial for a microscopical examination. This is especially true if the tumor is located along the shaft of the bone and not in the neighborhood of a joint. In case the patient is unwilling to submit to an exploratory operation, very careful and frequent observations will soon determine the true character of the disease. If it is sarcoma, there will be steady and fairly rapid increase in size, if myositis ossificans, but very slow increase in size, if any, is noted.

Treatment.—The question of treatment is an extremely important one. Yet the data at the present time would seem hardly sufficient to warrant the laying down of any absolute rule. Jones states that "if we operate early, we risk leaving histological elements behind. If we operate late, apart from the greater destruction of tissue, the proceeding is sometimes very difficult. With our limited experience we would suggest early operation, feeling it would be wiser to risk the performance of a second operation in an endeavor to prevent the spread of trouble, than to delay operative interference, which might result in exuberant development of bone."

Jones, however, in a letter to Mr. Godlee (*Trans. Royal Soc. of Med., Surg. Section*, 1911), admits that further experience led him to considerably modify his original opinion as regards treatment. In this letter he states: "Since writing the article I have come upon cases where the deposits, instead of increasing, have decreased, and I am not now at all convinced of the value of operation. The simplest looking mass in the bend of the elbow is a very difficult problem to negotiate operatively, and I have on more than one occasion wished I had left the whole thing alone."

A careful review of the cases thus far recorded would lead one to conclude that no single method of treatment is applicable to all cases. The two very interesting and most typical cases, carefully reported by Makins (*Trans. Royal Soc. of Med.*, 1911, p. 132) furnish further strong ground for first trying conservative treatment. These two cases, as shown by the history and radiographs, are almost identical with my first case. Makins's cases were both young adults;

in both the disease occurred in the quadriceps muscle, one followed a football injury, the other the kick of a horse. In both cases he was able to show radiographs taken six years after the original injury, demonstrating almost complete resorption of the bony tumor.

With regard to treatment, Makins states: "As to the general line of treatment to be adopted, a period of some weeks' complete rest should be maintained during the continuance of the active progress of ossification. When it is judged by clinical observation and X-ray examination that progress has ceased, or the process is retrogressive, massage and exercise should follow. Operative treatment should only be considered when the process has manifestly come to a definite standstill, and the patient suffers from functional disability which there is a chance of relieving."

Godlee's case (*l.c.*) still further shows the advantages of conservative treatment. Godlee stated that Mr. Clutton operated upon two similar cases in which the operation had done harm, and he strongly urges "the advisability of leaving these swellings alone until ample time has been allowed, at least a year for the absorption of what may be called provisional callus. Even after this time, I think that removal would only be justified if the mass were causing mechanical inconvenience and pain. It must be remembered that the operation is inflicting another traumatism upon a part, which for some reason has shown a special tendency to the development of bone, and it cannot therefore be surprising if renewed activity of the process should follow."

Some advise early incision and evacuation of the extravasated blood, but this is of doubtful expediency and not to be recommended. Massage is, likewise, inadvisable.

Finney has this to say as regards treatment: "There is an unfavorable as well as a favorable time for operation. It should never be recommended early in the development of the bony tumor, even for diagnostic purposes, since, if we have to deal with a subperiosteal sarcoma, it is of doubtful efficacy, and in this condition the tendency to recur at this stage is very great. If the operation is performed when increase in the size

of the tumor is no longer present and its consistency has become harder, the chances of a recurrence are very materially lessened. The operation should consist in a thorough excision with ample margin of all the osteoid tissue, including some healthy muscle. The underlying periosteum should be thoroughly excised and the shaft of the bone cleaned off until a smooth surface remains. Cauterization with the actual cautery of the denuded bone surface has been recommended. Operation is not recommended in every case; many of them recover under rest and later massage and active and passive motion."

I cannot agree with Finney in advising against exploratory operation for diagnostic purposes. He states that, if we have to deal with a subperiosteal sarcoma, it is of doubtful efficacy. This advice is evidently based on the generally accepted belief that subperiosteal sarcoma is an entirely hopeless condition. Yet we now have a rapidly increasing number of cases of subperiosteal sarcoma which have been cured (and are well over three years) either by the mixed toxins of erysipelas and *Bacillus prodigiosus*, alone, or by the toxins combined with operative treatment. One such case I have the pleasure of showing this evening. This case, a round-celled subperiosteal sarcoma of the femur with extensive multiple metastases, recovered under the toxins and remained well over ten years. A full report of this case will appear in a later number of the ANNALS OF SURGERY. Another important case in point is the case of Williamson (*Transactions of N. Dakota Med. Soc.*, 1910), periosteal round-celled sarcoma, confirmed by microscopical examination by the pathologist of the State Laboratory, and pronounced too far advanced for hip-joint amputation by Dr. W. J. Mayo, who advised the mixed toxins. The patient entirely recovered, with a normally useful leg, and is now well $3\frac{1}{2}$ years later. I do not believe that the small exploratory incision with removal of sufficient material for diagnosis, does any harm in either condition in ordinary cases, and may be of the greatest value in enabling the surgeon to at once advise the proper method of treatment.

In laying down any general rules for the treatment of myositis ossificans, I believe with Lapointe, that sharp distinction should be drawn between the two classes of myositis ossificans, *i.e.*, the cases occurring along the diaphysis of the bone and those situated in the neighborhood of a joint. The latter cases are often complicated with ossifying periarthrititis which greatly affects the operative prognosis. While in a number of the cases recorded in the literature there has been a true recurrence after operation, in no case has the size of the recurrence reached that of the original tumor. Lapointe was able to find only 2 cases that had been re-operated upon after recurrence, the cases of Hoffmann (*D. Militär-ärztl. Zeitschr.*, 1902, vol. xxxi) and Patry (*Soc. méd. de Genève*, 28 janvier, 1909). In the case of Patry there were three successive operations at intervals of a few weeks. The third recurrence was not operated upon, but finally disappeared and the patient fully recovered the function of the extremity.

The thesis of Chabrol (*Contribution a l'étude des ostéomes musculaires*, etc., *Thèse de Paris*, juillet, 1912) gives the latest facts bearing upon the end results of operation. In 95 cases which he collected there was complete restoration of function in 77; improvement was noted in 15, and no improvement in 3 cases.

In the cases in which the lesion occurred in the neighborhood of a joint, in which there was more or less coexistent ossifying periarthrititis, the results were not as good. Chabrol found 25 cases of extirpation of the anterior brachial muscle after dislocation, with complete restoration of function in 8, improvement in 8, and no improvement in 9.

Lapointe's conclusions as regards treatment are that prophylactic measures are uncertain; the value of conservative treatment is more apparent than real and explains the spontaneous regression of the ossifying process which, in time, often results in complete restoration of function. He believes that extirpation six or eight weeks after the trauma is the method of choice in cases not complicated with ossifying

periarthrititis. In some of these, the more severe cases, resection may be advisable.

NOTE.—I desire to express my great indebtedness to Dr. Byron C. Darling, not only for his very excellent radiographs but also for his valuable help in preparing and arranging the illustrations.

I further wish to express my appreciation of Dr. James Ewing's hearty coöperation in the matter of pathological reports and microphotographs.

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**SUB-TEMPORAL MUSCLE DRAINAGE BY THE AID
OF SILVER WIRE DRAINAGE MATS IN CASES
OF CONGENITAL HYDROCEPHALUS.**

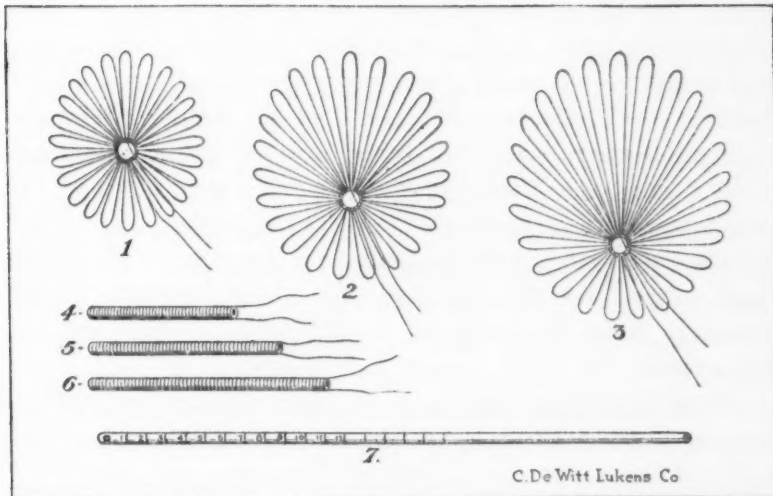
BY WILLIAM H. HUDSON, M.D.

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IN cases of congenital hydrocephalus where drainage underneath the scalp is attempted the writer has found a vast additional drainage capacity by using the under surface of the temporal muscle for the absorption surface by inserting under this muscle silver wire drainage mats. Where this is to be attempted the operation should be done in the following manner: The usual point for perforating the skull dura and brain, posterior and above the right ear is selected. An incision about two and one-half inches long, with its curve in a backward direction, is made down to the temporal muscle. A point about an inch in front of the curved incision is selected, and the fibres of the temporal muscle separated at this point. A flat separator with its point hugging the bone closely is pushed in every direction to its line of insertion under the entire skull area of the temporal muscle. Then the skull is opened with a self-stopping spiral perforator, its bottom cleared with the smallest size self-stopping burr. The dura is then split the full extent of opening in the skull. The two edges of the dura are then caught with mosquito forceps and the incision held open as far as possible. Through this opening a long, dull-pointed ventricular puncturing tube is inserted into the brain until the cerebrospinal fluid flows from its open end. The depth is read off on the side of the tube, which is marked in quarter inches. The permanent drainage tube is then cut to its proper measured length, and then slipped over the puncturing tube and carefully rotated to its proper permanent location in the brain, the two lateral fixation wires being carefully preserved. The silver drainage mat, which was fixed under the temporal muscle immediately after the muscle was separated

from the bone, is now fixed in position, and the fixation wires of the permanent tube carefully twisted around the central ring of the drainage mat. The temporal muscle is then carefully sewed over the mat and tube with the finest possible black silk. The incision in the scalp is also closed with the finest possible black silk. This operation must be done under the strictest aseptic precautions, with the use of new rubber gloves and the most careful sterilization of the patient's scalp.

FIG. 1.



1, 2, 3, silver wire drainage mats of different sizes. The fixation rings should be shown nearer the edge of the mats. 4, 5, 6, permanent drainage tubes of coiled silver wire of different lengths with fixation wires. 7, brain puncturing tube with dull round end, marked in quarter inch lines. The opposite end should be marked in the same manner beginning with 1, so that this end could be used as a measure for the permanent drainage tubes. The puncturing tube should not be removed until the drainage tube is properly placed.

A loose dressing finished with plaster-of-Paris bandages should be applied in such manner that no direct pressure is applied over the operation wound or the temporal region of the operated side. The greatest possible accuracy and delicacy of operative procedure should be observed.

In Fig. 1 are shown three sizes of the drainage mats, three lengths of permanent drainage tubes, and one puncturing tube marked at its puncturing end in one-quarter inches. The other end should be marked in the same manner so that that end may be used for measuring the permanent drainage tube before it

is cut. The permanent drainage tubes, as shown here, are made of coiled silver wire. It is possible they would be better if made of the thinnest gold, or silver, or platinum plate, with the fixation wires soldered to the ends of these tubes. Generally it would be necessary to cut them at the time of use. Cutting these thin tubes with a pair of scissors makes sharp corners which may cut the cortical vessels when the tubes are inserted. So, if solid tubes are used, it is best to cut them with a sterilized file, cutting through the wall of the tube its entire circumference. The tubes made of coiled silver wire can be cut with the point of a pair of scissors without constricting them. All that is necessary is to cut the wire at one point after the lateral holding wires have been cut. In inserting the mat under the temporal muscle a spooned brain spatula should be pushed well under the temporal muscle. If any difficulty is encountered the silver wire loop should be pushed home carefully and accurately with the point of a silver probe which has been notched for this purpose. The mats should be placed smoothly under the temporal muscle, being careful that the loops reach well down toward the zygoma.

Two small drill holes made on either side of the trephine opening in the skull through which the fixation wires are passed will add somewhat to the stability of the mats and tubes.

THE THYROGENIC ORIGIN OF BASEDOW'S DISEASE.

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It is now about twenty-five years since Moebius emphasized the importance of the thyroid gland in Basedow's disease and advanced the theory that in the hyper-activity of the gland we find the cause of the symptom-complex which is generally known as Basedow's disease. It was in 1887 that Moebius published his classical treatise upon this subject. The treatment of this disease since that time has for the most part been based upon this hypothesis, and remedies both medical and surgical have been employed which were designed to check the activity and thereby diminish the secretion of the thyroid gland. So general has this hypothesis become that the thyroid origin of Basedow's disease has been practically accepted by the medical profession the world over.

While from a clinical, and we might perhaps say also from an experimental, standpoint the thyroid origin of the symptoms of this disease seems well established, yet there are many problems still to be solved. The primary cause of the thyroid change is as yet unknown, while much confusion and contradictory evidence exists throughout the literature, especially relating to the questions of hyper- and dis-thyroidism as the essential elements in the disease.

Marine and Lenhart¹ have written extensively against the present conception of this disease and endeavored to show, through experimental observations made by themselves as well as the observations of others, that the Moebius theory has never been proved and therefore the present methods of treating Basedow's disease are not based upon a proper foundation. Marine and Lenhart have come to the conclusion that the thyroid changes are not the cause of the symptoms of the disease, but that the involvement of this gland is only a part of a general disease and is therefore only symptomatic; that the

only disturbance of the thyroid in this disease is that of functional insufficiency, while its reaction is only compensatory.

Marine of Cleveland, before the Surgical Section of the American Medical Association, at its recent meeting in Atlantic City, again reviewed the experimental evidences for and against the hyperthyroidism theory of Basedow's disease, giving the same conclusions as before, mainly that the hypothesis of Moebius was as yet to be proved.

C. F. Hoover² bases his views upon the investigations of Marine and Lenhart, and seriously questions the present surgical treatment of Basedow's disease. Hoover is of the opinion that the disease is not of thyrogenic origin, and that the good results obtained from the surgical treatment cannot be explained upon the basis of hyperthyroidism.

It is interesting, from a practical surgical standpoint, to note the opinions expressed by those who are opposed to the thyrogenic origin of the disease in explanation of the good results following its surgical treatment; such results are explained as being due to the rest in bed, psychic causes, suggestions, or, as Carlson (3, p. 130) says, that they are perhaps "instances of spontaneous recovery."

The arguments usually given for dissenting opinions against the Moebius theory may be grouped as follows:

First.—The unknown factor or cause of the increased activity of the gland.

Second.—The failure of both medical and surgical treatment to cure all cases of Basedow's disease.

Third.—The occasional spontaneous cures which result from other forms of treatment, such as rest, nerve sedatives, etc.

Fourth.—The apparent inability to reproduce the disease experimentally in lower animals.

Fifth.—The refutation and rejection of published experiments in which the disease has been produced in lower animals.

Sixth.—Ascribing the cure to some other factor after surgical treatment rather than to the operation itself; such as the relief of pressure, rest in bed, psychic treatment, etc.

It is the purpose of this paper to review the chief clinical

and experimental evidences in favor of the thyroid origin of the symptoms of Basedow's disease as a justification of the present surgical methods in its treatment. It seems to me that sufficient time has now elapsed to have tested the thyroid theory to such an extent, at least from a clinical standpoint, that we particularly as surgeons feel warranted in claiming that in the thyroid gland we find the chief cause of the symptoms of exophthalmic goitre.

EXPERIMENTAL HYPER-THYROIDISM AND BASEDOW'S DISEASE.

CARLSON,³ in a most excellent article, reviews the attempts to produce the experimental hyper-thyroidism in animals and birds, and adds some very interesting experiments of his own. His work is particularly directed to the refutation of the theory of hyper-thyroidism. He states that the prevalent view regarding the etiology of exophthalmic goitre is based upon "(1) the structural changes in the thyroids, (2) the effects of partial extirpation of the gland, (3) the aggravation of the symptoms by thyroid administration, (4) and the alleged production of some or all of the symptoms in healthy individuals and experimental animals by thyroid administration."

Regarding the structural changes in the thyroid glands of Basedow's disease, he thinks their significance has been a matter of inference rather than of direct demonstration, as such changes are variable and may signify an *altered* secretion rather than an *excessive* secretion, and seems to agree with Marine that some of the cardinal symptoms of exophthalmic goitre are effects of some disturbance of metabolism and not primarily the direct result of the thyroid changes. He publishes a large number of experiments in the feeding of thyroid extract upon a great variety of animals and also one experiment upon himself. While Carlson was able to produce toxic symptoms and obtain symptoms of loss of body weight, gastro-enteritis, and dysentery, he concludes: "It would require considerable imagination or an undue influence of one's wish or one's judgment to identify the symptom-complex of excessive thyroid feeding in experimental animals with the exophthalmic goitre syndrome in man. The symptoms in experimentals may or may not be an expression of hyper-thyroidism. Other lines of investigation must determine that point. The symptoms are not those of exophthalmic goitre."

KLOSE,⁴ in his address before the German Surgical Congress of 1911, states that in spite of all the advances that have been made in the investigations of Basedow's disease by Kocher and others we do not know at the present time whether the disease is due to a hyper- or dys-thyroidism; whether the variation from the normal is a quantitative or qualitative one. Klose injected intravenously thyroid pressure fluid, or "press-saft" (taken from fresh Basedow thyroids), in over one hundred animals. He was apparently able to produce typical Basedow's

disease in these animals. The symptoms following the injection were elevation of temperature, irregular pulse, disturbances of respiration, tremor, sweating, and the elimination of albumin and sugar. In rare instances exophthalmus was noticed. The blood-picture showed for a short time an increase in the general amount of leucocytes, especially of the polynuclear cells, but the typical blood-picture of Basedow's disease, or lymphocytosis, soon followed. A marked reduction in the blood-pressure was also noted. The blood-picture following the injection was so characteristic, as compared to the injection of "press-saft" obtained from the ordinary or simple struma, that Klose regards it of value as a differential diagnostic method. Klose found also that the intravenous injection of potassium iodide in dogs gave a very similar reaction. He therefore came to the following conclusions: that Basedow's disease is not a hyper-thyroidism, but rather a dys-thyroidism. The thyroid gland does not have the normal activity for storing up iodothylin, but rather permits it to be carried into the circulation in a form which is as yet unknown, but to which Klose has given the arbitrary name of "Basedowiodine."

BIRCHER,* in a recent contribution, as well as in his previous article published in the *Bd. 1 des 15 Jahrgangs der Ergebnisse der allgemeinen Pathol. u. pathol. Anat.*, p. 225, reports his endeavors to experimentally reproduce Basedow's disease. In his later experiments he employed implantation of thymus gland into the peritoneal cavity of lower animals. Bircher was led to these experiments by the reports from other authors (Capelle, Thorbecke, Hart, Grecke, Garre), who reported a large number of thymus deaths in cases of Basedow's disease. He therefore came to the conclusion that in Basedow's disease the thymus gland plays an important rôle, and that its importance in this disease is even as great as that of the thyroid gland itself. He was especially impressed with this thought after looking over the statistics of deaths from Basedow's disease and of its cure by Garre following the operation of thymectomy and also by the production of Basedow's symptoms after the injection of thymus juices. Bircher relates that in five dogs he has produced the whole picture of Basedow's disease in a manner so pronounced as had heretofore never been observed. In these experiments Bircher used pieces of thymus gland which he obtained from patients who did not suffer from Basedow's disease but rather died from persistent thymus gland and narcosis shock or from cases of stenosis of the thorax in which a thymectomy had been performed. The pieces of thymus gland were used in a very fresh state, exposed to the air for only about a half minute, and directly implanted into the peritoneal cavity of dogs. He publishes a photograph of one of these dogs showing the typical picture of Basedow's disease,—i.e., exophthalmus and enlarged thyroid gland. In this dog a piece of thymus gland about one centimetre thick, obtained from a case of endemic Cretinism, was implanted into the omentum. The first symptoms manifested themselves after forty-eight hours. The dog became very irritable and excited and sprang about his cage like one possessed. He took but little nourishment and had an enormous thirst; the exophthalmus showed itself on the fourth and reached its height

after the twentieth day, remained stationary for a few days, and then became less apparent. It did not disappear entirely until after five months. On the third day tachycardia appeared, the pulsations became very rapid, as high as 180, there was also a tremor of the legs and paws, as well as of the whole body. The enlargement of the thyroid gland could still be felt after four or five weeks. At the end of the first week a pronounced lymphocytosis was present, which, however, did not persist. The appetite was greatly diminished; a diet rich in albumin produced glycosuria—no pronounced dysentery. The tachycardia lasted three months, but the enlargement of the thyroid remained after most of the other symptoms disappeared.

Two of these dogs were allowed to live for further study; in the other three the operation of total thyroidectomy was performed. These animals died very rapidly from acute cachexia thyreopriva.

Bircher thinks that these experiments, which for the first time have produced so pronounced and typical an exophthalmus, demonstrate the correctness of the correlation of Basedow's disease with the function of the thymus gland.

BARUCH,⁷ in a recent contribution, reviews the work of Bircher as well as his own experiences, now of several years, in the experimental production of Basedow's disease. Baruch states that for such experiments he used ordinary goitres, usually of the parenchymatous variety, or simply the colloid variety. These goitres were prepared freshly a few hours after the operation, ground up very finely so that it could be injected into the animals through a cannula of large calibre. Injections were made either subcutaneously or into the peritoneal cavity, usually the latter. With this method he produced typical Basedow in a large series of dogs as well as in rats and rabbits. After injection the dogs showed unusual irritability and nervousness, decided emaciation, loss of hair and dysentery, tachycardia, glycosuria, lymphocytosis, and, in a few instances, pronounced exophthalmus. Three of such dogs with exophthalmus were demonstrated by Baruch on July 10, 1911, before the Breslau Surgical Association. One of these dogs, as a result of lagophthalmus, developed an ulcer of the cornea. For these experiments he found that very young animals, especially females, were more susceptible. He injected from five to twenty centimetres of the macerated gland, usually extending over a period of eight days. The exophthalmus usually developed on the twelfth or fourteenth day. Baruch claims that in the experiments of Klose the toxic principle of the Basedow thyroid gland is to be found only in very small quantities,—i.e., "press-saft," as used by that investigator. Parallel experiments to those of Klose were made by Baruch in which he used the Basedow thyroid gland instead of the ordinary small forms of goitre, and he found that he could produce the symptoms of the disease much quicker and more often than with the ordinary gland. Baruch believes that the toxic principle does not leave the thyroid gland and enter into the "press-saft." Baruch states that his experiments, as well as those of Bircher, demonstrate the interesting fact that one can reproduce the typical picture of Basedow's disease by the employment

of certain tissue which does not necessarily come from a patient with Basedow's disease.

FRENCH⁸ undertook to study the comparative toxicity of different tissues in animals susceptible to thyroid feeding, the object being to discover whether the effects of commercial thyroid extract when administered are specific or whether similar effects could be produced by other animal tissues prepared and administered in the same way; "Whether it is due to decomposition products or whether it is due simply to the great amount of proteid matter ingested by an animal unaccustomed to such a diet." His conclusions were as follows:

1. Thyroid in the forms used—fresh, stale, and desiccated, either commercial or laboratory prepared—contains a substance that is decidedly toxic for some animals.
2. The other animal tissues used—brain, liver, spleen, kidney, and skeletal muscle—give no evidence of toxicity when prepared and fed in the same way in equal or even larger quantities.
3. While the study does not indicate the nature of the toxic substance, it would seem to show conclusively that it is not due to protein in the food.

Thymus Gland.—The correlation of the ductless glands of the body in their functional activity has led to many theories regarding the cause of the primary thyroid change in Basedow's disease. The most important ductless gland which experimental and clinical evidences seem to show to be intimately associated with the thyroid is the thymus gland. This gland has been found persistent in severe cases of Basedow's disease and has been experimented with by Bircher in the artificial production of the disease, as already given above, and to it has been ascribed the essential factor in producing the thyroid change. The thymus gland has even been removed for the cure of Basedow's disease, and apparently with good effect.

MATTI,⁹ in showing the relation of the enlarged thymus gland to exophthalmic goitre, reports ten cases of his own and has compiled one hundred and thirty-three cases from literature. He states that fully 76.5 per cent. of all exophthalmic patients who died after operation had an unusually large thymus gland. Matti states that it seems very evident that the thymus and thyroid gland are in concert, and that each aggravates the morbid condition induced by abnormal functioning of the other.

GARRE¹⁰ states that the conception of a surgical operation upon the thymus gland for the relief of Basedow's disease was based upon the fact that in cases of severe and fatal forms of Basedow's disease death is almost without exception due to a persistent thymus. In one case of

severe Basedow's disease he performed a thymectomy without touching the goitre, and obtained improvement in the heart's action, the disturbance of the characteristic Kocher's blood-picture, and a decided increase in the body weight. In a second case he performed the operation, but at the same time removed one-half of the thyroid gland, and obtained a good result. He quotes Capelle, who claims that the symptoms of Basedow's disease are intensified in the presence of an enlarged thymus gland. He draws the following conclusions regarding the correlation of the thymus and thyroid glands in Basedow's disease:

First.—After extirpation of the thymus gland the characteristic blood-picture of Kocher disappears, just as it does after successful thyroidectomy.

Second.—His assistant, Doctor Bayer, has been able to reproduce the typical blood-picture in animals by the peritoneal injection of thymus pressure fluid from a case of Basedow's disease.

Third.—After the removal of the thymus gland six months later retrograde processes were observed in the thyroid gland removed at a secondary operation and subjected to microscopic examination.

Fourth.—In thyroidectomized animals Gebele, by the employment of the thymus gland, was able to prevent the typical condition of cachexia strumepriiva.

Fifth.—The experiments of Bircher, who has been able to reproduce pronounced Basedow's disease in dogs by the intra-peritoneal implantation of fresh pathological persistent thymus.

Garre does not wish to go so far as Hart, who speaks of a thymogenic cause for Basedow's disease, but thinks that there is a certain group of Basedow cases which are complicated by a persistent hyperplastic thymus gland. These cases can be characterized as severe types of the disease. He further relates (p. 58) that persistent thymus gland is found in ninety-five per cent. of all fatal cases of Basedow's disease in which a thyroidectomy had been performed.

CROTTI and BOWEN¹¹ have emphasized the importance of the enlarged thymus gland in those cases of death following the operation of thyroidectomy for Basedow's disease and have been able to diagnose enlargement of the thymus gland with the Röntgen ray. They reported five cases of this kind.

CAPELLE and BAYER,¹² in their contribution on thymectomy in Basedow's disease, state that they and others are of the opinion that the symptoms of Basedow's disease are made more severe when a thymus gland is present, but do not agree absolutely with Hart, who goes still further and ascribes to the thymus gland (Hart, *Münch. med. Wochenschrift*, 1903, 13, 14) the primary cause of Basedow's disease in its direct action by producing pathological changes and oversecretion of the thyroid gland.

V. MIKULICZ^{13 14 15} came to the conclusion that the conception of Basedow's disease should in no way be explained solely through an excessive function of the thyroid gland. His conception of the disease as given by him before the German Surgical Congress of 1895 is that the thyroid gland acts as a multiplier or intensifier of the symptoms.

In view of the experimental production of Basedow's disease through the transplantation of the thymus gland by Bircher, as well as the experiences of Garre with thymectomy as a cure for Basedow's disease, it is not at all improbable that the "multiplier" theory of Mikulicz with the thymus gland as the primary lesion may perhaps be correct.

Artificial Clinical Production of Basedow's Disease and Hyperthyroidism.—Basedow's disease has been accidentally produced in man by the excessive administration of thyroid extract and iodine preparations. It is a well-known clinical fact that the administration of such remedies to patients suffering from exophthalmic goitre will cause an exaggeration of all of the symptoms.

Von Notthaft¹⁶ reports a very interesting case of a man in whom artificial production of acute Basedow's disease occurred from the use of thyroid extract taken for obesity. The man developed a typical picture of Basedow's disease, exophthalmus, tachycardia, nervousness, emaciation, and glycosuria, the symptoms disappearing again after ten months. This case has become classical in the literature of Basedow's disease, and a detailed abstract of it will not be amiss.

VON NOTTHAFT'S case was as follows:

Male, aged 43, who had always been well, with no neuropathic taint, no alcoholic or venereal history, suffered for several years from progressive obesity. The associated discomfort led him to take various "cures."

The results following these obesity cures were not good, and he then tried the use of thyroid tablets (thyroidin) without consulting a physician. In December, 1896, he procured, through the aid of a druggist friend, some thyroid gland tabloid preparations of Burroughs, Wellcome & Co. (0.3g) and within a period of five weeks he used about 1000.

He began with 3 tabloids t.i.d., and as the results were not rapid enough to suit him he took 10 tablets t.i.d., and later 15 tablets t.i.d. He lost about 30 pounds in weight, weighing 220 pounds when he began, a decrease of about 13.64 per cent., an exorbitantly high ratio. The first symptoms of Basedow's disease set in at the end of the third week and were evidenced by an irritative cough with swelling of the neck. At the end of the fourth week the neck enlargement had increased, and palpitation of the heart, with insomnia, was present. About the end of the fifth week he experienced excessive thirst.

Toward the end of the third week his symptoms grew worse, and by the end of the sixth week he desisted in further self-medication and consulted medical advice. After the appearance of the irritative cough,

he observed that his shirt collar was too tight; the circumference of the neck seemed to have suddenly increased about 3 centimetres; he became dyspnoic and had palpitation of the heart. Fatigue and depression were marked. He became so excitable that he could not sleep at night; this was coupled with the fact that he could hear his neck arteries beat. His appetite remained undisturbed, stools and urine were normal. An attack of rheumatism in the last days of the treatment he ascribed to the excessive sweating which had been present for some days. The loss of weight was as follows:

At beginning.....	220 pounds; 3 tablets t.i.d.
Middle of first week.....	? pounds; 10 tablets t.i.d.
Towards end of first week.....	218 pounds; 10 tablets t.i.d.
End of second week.....	214 pounds; 10 tablets t.i.d.
End of third week.....	206 pounds; 10 tablets t.i.d.; first symptoms.
Beginning of fourth week.....	? pounds; 15 tablets t.i.d.; increased symptoms.
End of fourth week.....	200 pounds; 15 tablets t.i.d.; insomnia and palpation.
Beginning of fifth week.....	? pounds; 2 tablets t.i.d.
End of fifth week.....	196 pounds; 2 tablets t.i.d.; thirst excessive.
Beginning of sixth week.....	192 pounds; until then 3 tablets t.i.d.

Upon examination on January 15, 1897, the following were the physical findings:

Adiposus well developed, the face is slightly reddened; the entire skin feels very moist. At first glance one notes two prominent symptoms: considerable exophthalmus and a moderate tremor, which is more pronounced in the hands. The neck is thick, and a marked enlargement of the thyroid gland can be noted, the neck circumference at the largest point is 47 centimetres. Palpation shows the thyroid with both lobes considerably enlarged (*Nicht unerheblich vergrößert*); palpable thrill and vascular sounds are not present. The carotids and brachials pulsate visibly. Pulse is soft, regular, 120; respiration about 24 and more. Axillary temperature, 37.3° C., weight 192 pounds. Liver and spleen unchanged. Abdomen soft, not sensitive to pressure. Lung and heart outlines normal; apex beat increased and widened in fifth intercostal space, within the mammillary line. Exophthalmus equally prominent on both sides; can completely close the lids; Stellwag's sign is clearly noted, and on lowering of the visual level the upper eyelid moves only imperceptibly downward (Graefe's sign). Pupils react, vision, eye grounds and power of convergence show no abnormality. The protruded tongue trembles markedly, as is the case in a patient affected with cerebral lesion. The urine contains 1 per cent. of sugar; daily quantity 3 litres plus.

Thyroid medication was stopped at once; hypnotics and Fowler's solution were administered. In ten days improvement was first manifested by an improved mental condition, then the nervousness abated, and fourteen days after the first consultation the patient stated that he felt better than ever. The sugar in the urine disappeared after ten days. The polyuria and thirst began to disappear after this. For about four weeks no effect was noted on the heart and pulse, then slowing of the pulse-rate to 80 and 90; but even eight weeks after examination slight excitement sufficed to run it up to 110 and 120. At this time the apex beat was hardly palpable any longer. The irritative cough left after the eighth day; the tremor was no longer observed after four weeks. On the other hand, struma, exophthalmus, and the other eye phenomena remained for six months and then gradually receded. In October,

1897, the patient was again examined and none of these symptoms were found. In the meantime the patient (without the doctor's knowledge) took 0.3g. t.i.d. of iodothylin and remained well. His weight is now 204 pounds.

BALL¹⁷ reports a very interesting case of exophthalmic goitre with acute symptoms and death probably caused by the use of thyroid extract. Patient was a female, aged 24, who had been taking five-grain tablets of thyroid extract for over a year to reduce a thyroid swelling. Death took place from acute thyroidism. Before death, temperature reached 106, pulse 200, respiration 70. The acute symptoms lasted less than four weeks. Autopsy gave negative findings relating to the cause of death other than that of acute exophthalmic goitre.

THEODORE KOCHER^{18 20} reports a case of acute Basedow's disease as the result of the internal and local treatment of a simple goitre with iodine preparations. After three weeks the patient had all the typical symptoms of Basedow's disease, and after extirpation of the thyroid, which was about the size of a man's fist, it was found to contain an unusually large amount of iodine. Kocher thinks this condition should be termed iodism of the thyroid gland, as the symptoms are identical with those that are obtained by the administration of large doses of thyroid extract. He states that mild symptoms of Basedow's disease are to be observed very often in cases of ordinary goitre where there is a misuse of iodine. He has designated this condition as a special form of the disease, namely, "Iodbasedow" or "Iodinebasedow."

PINELES²¹ verifies Kocher's observation, and reports six cases of Basedow's disease produced through the administration of iodine.

PULAWSKI¹⁹ reports three cases in which he observed Basedow symptoms developed after the treatment by iodine and thyroid extract.

WOLFSOHN²² experimented to determine the sensitiveness of Basedow patients to the ingestion of iodine preparations. He utilized for these experiments guinea pigs in which he had previously injected serum obtained from Basedow patients. He found that after twenty-four hours these animals were oversensitive to iodoform.

SELLI, BERG, and WOLFSOHN²³ have observed thyroidism and acute thyroiditis after the administration of potassium iodide and iodine preparations.

THEODORE KOCHER²⁴ relates that Tourin, one of his assistants, has examined a large number of cases of ordinary colloid goitre and found no change in the normal blood-picture. However, after the administration of iodothylin he obtained the typical blood-picture of Basedow's disease,—i.e., typical leucopenia with diminution in the neutrophile cells, with an increase in the lymphocytes.

Pathology of the Thyroid Gland in Basedow's Disease.—Specific changes in the thyroid gland for Basedow's disease have been described by the Kochers, MacCallum, Wilson and MacCarty. An enlargement of the thyroid gland is always present in Basedow's disease. This has been commented upon frequently by C. H. Mayo and the Kochers. A case of Base-

dow's disease without an enlarged thyroid gland at operation is as yet to be demonstrated.

A. KOCHER,³⁵ in a histological and chemical examination of one hundred and sixty thyroid glands removed from cases of Basedow's disease, thinks that the conception of a papillary cylindrical cell hyperplasia as the specific histologic picture is not at all satisfactory, as such changes are only found in herds or may be entirely absent. This conception has given rise to the belief that there are no changes in the thyroid gland which are absolutely characteristic of the disease. Personally, A. Kocher agrees with the latter view. Kocher found all manner of changes in the one hundred and sixty cases examined, and definite conclusions could only be arrived at after taking into consideration the microscopic picture, the clinical examination, and the patient's history. The composite picture which Kocher obtained that might be said to be characteristic for Basedow's disease can only be expressed by saying that "evidences of increased absorption in all parts of the gland are to be found." In such glands there is found constantly increased liquidation of the contents of the follicles, with a relative or absolute enlargement or increase of the cells. These changes were dependent upon the amount and concentration of the iodine content of the follicles. He states that in Basedow's disease the thyroid gland takes up more iodine than does the normal gland. This storing up of iodine as compared with the normal gland varies greatly,—in other words, no relative proportion between iodine content and colloid, as is the case in the normal state. A more liquid iodine-containing content of the follicles gives a severe form of Basedow's disease.

Basedow symptoms do not occur where there is a dense content of the follicles. When such is the case there is usually an improvement in the general condition of the patient, while an increase of the iodine content without thickening of the content means an exaggeration of the symptoms. In Basedow's disease more iodine is taken through the thyroid gland than in the healthy state. The increase in vascularization was more pronounced in those cases where the secretion in the follicle was thin.

Histologic changes are dependent and secondary to the variation in the composition in the follicle content. He comes to the conclusion that in Basedow's disease there is a greater increase and absorption of thyroid products into the general circulation.

A. KOCHER³⁶ again reports the examination of thirty-five thyroid glands removed from patients with Basedow's disease, and states that his experience is now so extensive that from the clinical manifestations he is able to predict the exact histological conditions which will be found in the thyroid. He classifies them under four different groups. Kocher has been experimenting with the transplantation of portions of Basedow thyroids in patients suffering from hypo-thyroidism, as well as with desiccated Basedow thyroids. The effect seems to be the same as when the normal thyroid gland is used. Kocher thinks that this speaks for a hyperthyroidism as the cause of Basedow's disease and as an

evidence against the dys-thyroidism theory. He states that the amount of iodine found in the thyroid gland of Basedow patients varies greatly—either far above or far below the normal average.

WILSON and MACCARTY^{27 28} have described typical changes in the thyroid gland of patients suffering from Basedow's disease. These changes consist mainly in the histologic picture, showing an increase in the epithelial or secreting surface of the gland. In the Surgical Section of the American Medical Association, at its recent meeting, Wilson of the Mayo clinic made the statement that in eighty per cent. of the cases he could determine the clinical symptoms from the histologic findings.

MARINE and LENHART¹ report their studies of sixty-nine thyroid glands removed from exophthalmic patients. They found the changes variable. The most constant change, however, was found to be an active hyperplasia of the thyroid in connection with hyperplasia of all the lymphoid tissues. The exophthalmic goitre syndrome may co-exist with a normal thyroid, with a colloid goitre, with an active hyperplastic thyroid, as well as with an atrophic thyroid, or may be found with a tumor of the thyroid. They claim that active thyroid hyperplasia means thyroid insufficiency, and that the iodine content of the gland varies inversely with the degree of active hyperplasia. They also state that the degree of active lymphoid thyroid hyperplasia is therefore the best index of the severity of the disease.

Blood Changes in Basedow's Disease.—THEODORE KOCHER²⁹ reports accurate blood examinations in one hundred and six cases of Basedow's disease, and describes a characteristic blood-picture. This blood-picture consists in a reduction of the polynuclear neutrophile leucocytes with an absolute or relative increase in the lymphocytes. He not only holds this blood-picture as typical, but utilizes it for the early diagnosis of the disease as well as for its prognosis. Both medical and surgical treatment influence this blood-picture very much. After thyroidectomy the total number of leucocytes are increased. The neutrophile cells increase and the lymphocytosis diminishes. In this manner Kocher is able to prognosticate as to cure after surgical operation. As Kocher operates many of his cases in successive stages, beginning with ligation of one or more of the superior thyroid arteries and gradually leading up to the thyroidectomy; he can observe the amount of improvement after each operation by the blood examination. The blood examinations of Kocher have been verified by v. Lier, Buhler, Turin,³⁰ and others.

REID HUNT³¹ endeavored to throw some light upon the question of an excess of thyroid secretion in the blood of exophthalmic patients. He showed that when small amounts of thyroid extract are fed to mice for a few days the latter acquire markedly increased resistance to acetonitrile. He reports some experiments on white mice in which exophthalmic goitre blood was injected and the injection of normal blood used as a control. He states "That it required nearly twice as much acetonitrile to kill the mice which had received the exophthalmic goitre blood as it did those which had received normal blood or simply crackers." Reid Hunt thinks this evidence should be accepted as demonstrating that the blood of exophthalmic goitre patients contains thyroid secretions. These experiments were corroborated by Ghedini,³²

while Lussky,⁸³ after extensive experiments with the test upon several species of animals, as well as in one case in man, after thyroid feeding, states: "Inasmuch as there are, at least under certain conditions, other substances than thyroid in the blood which increase the resistance of mice to acetonitrile, and since these substances may vary in different individuals, or at different times in the same individual, the Hunt test on human exophthalmic goitre blood lacks sufficient control. In the case of positive results it is impossible to say which substances are present." The Kochers, however, regard Hunt's test of great value.^{24 20}

Secondary Basedow's Disease.—One of the most important facts which speaks for the thyroid origin of the symptoms of Basedow's disease is the so-called secondary form of Basedow's disease,—i.e., symptoms of hyperthyroidism or typical Basedow's disease appearing in connection with other affections of the thyroid gland, such as simple and adenomatous goitre, cancer and inflammations.

It is a common clinical experience with those who see many cases of goitre to have patients present themselves with a history of a long-standing enlargement of the thyroid, while the symptoms of hyperthyroidism or exophthalmic goitre are only of recent date. This has been observed and commented upon by Kocher (20, p. 10) and others.

The frequency of hyperthyroidism and Basedow's disease in association with malignant diseases of the thyroid has been observed by Bloodgood and Kocher.

Kocher^{24 20} speaks (p. 625) of cases of malignant struma which presented themselves with very pronounced symptoms of Basedow's disease, and the malignant nature of the goitre was not discovered until it was too late for radical operation.

Pieri⁸⁴ reports a case of spontaneous cure of Basedow's disease as a result of suppurative thyroiditis in which a part of the thyroid gland was destroyed by the inflammation.

Kocher's Conclusions.—Kocher,²⁴ 1911, in a very exhaustive *résumé* of the advances made in the study of Basedow's disease, states that the following conclusions relative to this disease are warranted:

First.—All cases of Basedow's disease are based upon pathological changes in the thyroid gland which produce a disturbance in the function of that gland. No one has as yet been able to demonstrate a Basedow case with normal thyroid gland. He has repeatedly shown enlargement of the thyroid gland in such cases at the time of operation where the thyroid gland could not be palpated before operation.

Second.—The disturbance of function manifests itself in the thyroid

excretion, which has a toxic action upon the nervous system. The only constituent of the thyroid gland whose physiologic and pathologic action is understood at the present time has been shown by Oswald and A. Kocher to be the iodine-containing thyro-globulin found in the colloid of the alveoli in the thyroid gland.

Third.—According to the researches of Bauman, Roos, Oswald, Reid Hunt, and A. Kocher, the thyroid secretion which enters the circulation depends upon the quantity of iodine which it contains for its action.

Fourth.—That Basedow's disease is a hyperthyreosis in the sense that either more secretion from the thyroid gland enters the circulation or, if not an excessive amount of secretion, an excessive amount of iodine.

Fifth.—Up to the present time we have no proof of a dysthyroidism in which the abnormal thyroid gland gives off its iodine content in the form of pure iodine. For the hyperthyreosis or hypersecretion as the functional disturbance of the thyroid gland in Basedow's disease we have the facts that by the administration of thyroid extract from normal glands in cases of cachexia thyreopriva the symptoms of that disease can be made to disappear. On the other hand, Basedow symptoms can be produced with the same extracts if given in large doses, while symptoms of the disease can be produced experimentally by the administration of thyroid extract, and the characteristic blood-picture as described by A. Kocher can be reproduced. This blood-picture is the most simple and best means of diagnosis in doubtful cases of Basedow's disease.

The Results Obtained from the Treatment of Basedow's Disease Based upon the Hyperthyroidism Theory.—The results obtained from treatment directed toward the overaction of the thyroid gland in Basedow's disease speak more in favor of the thyroid origin of the disease than do any other evidences or data which we possess at the present time. Such treatment has been either the (a) serum or antitoxin therapy, (b) the X-ray, (c) the surgical treatment.

(a) *Serum Therapy.*—The fact that there exists an antitoxin for this disease from which cures and good results are being obtained is one of the most potent arguments in favor of the thyroid origin of the disease. Various sera have been recommended and employed. These are prepared from animals from which the thyroid gland has been removed or from animals inoculated with extracts of thyroid gland taken from patients suffering from exophthalmic goitre. The serum of Moebius and that prepared by Rogers and Beebe are those most widely used. Good results from the serum treatment are reported by Rogers and Beebe³⁶ and Denic and Gardere.³⁷

The latter report in detail the cure of a pronounced case of Basedow's disease by the use of Moebius's serum.

BEEBE,³⁸ reporting the results obtained from the use of his serum, divides the cases into three groups. In the first group are those cases who have had the disease only for a short time, from two weeks to six months. In the second group are placed those patients who have had the disease for some time, from four to eight years. In the third group, those atypical cases which give the history of Graves's disease over a very long period of years.

The best results from the serum treatment are obtained with patients belonging to the first group; the percentage of recovery and marked improvement is 80 per cent. In the second group 50 per cent. of the patients may be cured or improved, while in the third group the serum finds its smallest application, and the treatment cannot be relied upon alone, and no definite statement regarding the serum treatment in this class of cases can be made.

(b) *X-ray*.—The fact that the X-ray applied only to the thyroid gland can modify, improve, or cure hyperthyroidism and Basedow's disease is another argument in favor of the Moebius theory.

RAVE³⁹ reviews the results obtained by the X-ray treatment of Basedow's disease and shows that the X-ray does have a favorable action upon the disease. He states that in fifty-one patients out of three hundred and twenty-one the nervous symptoms were improved. He comes to the conclusion that the X-ray treatment should be employed if for any reason an immediate surgical operation cannot be performed. He states that with this treatment the thyroid gland is reduced in size and specific symptoms of Basedow's disease, such as exophthalmus, cardiac and nervous symptoms, as well as the general condition of the patient, are improved. The patients also took on weight.

SIMON⁴⁰ reports a case of Basedow's disease treated by the administration of iodine in which there were very pronounced manifestations of iodo-thyroidism, which was brought to a cure in a very short time by X-ray treatment of the thyroid gland.

BERGER and SCHWAAB⁴ sent question blanks to a number of German internists asking for their experiences in the Röntgenization of the thyroid gland in the treatment of goitre. The majority of clinicians who replied stated that favorable results were obtained in Basedow's disease, and some regarded it as fully equal to any other therapeutic method.

The enlargement of the thyroid gland subsides after this treatment, as well as do the other specific symptoms of Basedow's disease.

(c) *Surgical Treatment*.—MELCHOIR,⁴¹ in the most exhaustive and complete *résumé* of the literature of Basedow's disease up to 1910, states that in the majority of cases of

Basedow's disease it is possible, through the diminution in the size of the goitre by surgical measures, to cure, or at least to produce an improvement which borders on absolute cure. He gives the available figures of 65 to 75 per cent. of cures, and further states that so far the operative treatment of Basedow's disease is the best remedy. The cure in some cases is proportional to the amount of thyroid tissue removed. The early operation is recommended for two reasons:

First.—That the operative mortality in advanced cases of Basedow's disease is very high, while in the beginning of the disease it is very low, not higher than that for ordinary simple forms of goitre.

Second.—Even if a successful operation is performed in advanced cases, the heart changes very seldom are relieved.

Melchoir reviews the results obtained as follows:

Wolff	1898.....	9 cases.
Helferich	1898.....	6 cases.
Von Mikulicz	up to 1900.....	18 cases.
Witmer and Kroenlein.....	1900.....	23 cases.
Kummell	in 1901.....	20 cases.
Curtis	in 1903.....	11 cases.
Koenig	in 1905.....	8 cases.
Hartley	in 1905.....	21 cases.
Riedel	in 1906.....	50 cases.
Garre	in 1908.....	28 cases.
Klemm	in 1908.....	32 cases.
Kocher	up to 1908.....	320 cases.
Mayo	up to 1907.....	176 cases.
Halstead	1907.....	90 cases.
Landstrom	1907.....	54 cases.
McCosh	1908.....	22 cases.
Hanel	1909.....	21 cases.

A total of909 cases.

There was approximately 65 to 75 per cent. of cures.

C. H. MAYO⁴⁸ reports over eleven hundred operated upon for hyperthyroidism at the Mayo clinic, and states that about seventy per cent. of the patients consider themselves cured, and apparently they are well. The others were improved but not well on account of late operation when severe secondary effects of disease were present.

H. ALAMARTINE and PERRIN⁴⁹ reviewed the results obtained by v. Mikulicz, Kroenlein, Kocher, Kummell, Riedel, Garre and Ackerman from their operations on the thyroid gland for the relief of Basedow's disease. They endeavored to determine the late results of the operation, and only those cases which had been under observation at least three years after the operation were considered. In 120 cases 85 or 70.8 per

cent. were absolutely cured; in 27, or 22 per cent., there was marked improvement, and in 8, or 6.6 per cent., there was no improvement.

The general favorable result, approximately 70 per cent. of cures as given above, seems to prove that not only is the thyroid gland the seat of the principal disturbance in Basedow's disease but that we cannot ascribe the cure to any other reason but to the operation itself.

Various methods of operation have been employed, such as ligation of the thyroid arteries, pole ligation, resection of the cervical sympathetic ganglia, resection of one lobe either alone or in combination with a hemi-section or ligation of the opposite lobe, but experience seems to show that the best results are obtained from the resection operations. The surgical treatment of this disease has been progressing and is better understood to-day than it was a few years ago, and many of the cases which formerly were not cured or relieved by a surgical procedure did not have a sufficient amount of thyroid tissue either rendered functionless or removed. At the present time there is no definite standard for the amount of thyroid tissue to be removed; this is largely a matter of judgment and experience with the operator.

Halstead ⁴⁴ states that although thousands of operations have been performed the world over, for the cure of Graves's disease, we are not as yet in a position to state how much of the thyroid gland should be removed in any given case. Some of the severest cases have been sufficiently cured by the removal of one lobe, and in some of the mildest the excision, almost total, of both lobes has been necessary to bring about a cure or a satisfactory condition.

CONCLUSIONS.

From the foregoing review of the experimental and clinical evidences relating to the thyroid origin of Basedow's disease the following conclusions are warranted, viz:

1. Basedow's disease can and has been produced experimentally in lower animals by the injection of thyroid pressure fluid (Klose), by implantation of the thymus gland (Bircher),

and by the injection of the macerated thyroid gland (Baruch). Symptoms closely resembling Basedow's disease can be produced in animals by thyroid feeding.

2. The evidence at hand indicates a close relationship between the thymus and thyroid glands.

3. That the symptoms of Basedow's disease are due to either an excess or perverted secretion of the thyroid, with the primary disturbance existing in the thymus gland, the action of the thyroid being that of a "multiplier" according to the theory of von Mikulicz.

4. Basedow's disease has been produced in man by the excessive administration of thyroid extracts and preparations of iodine.

5. That there are changes in the thyroid gland, chemically, macroscopically, and microscopically, which are characteristic for Basedow's disease.

6. Typical Basedow's disease or symptoms of hyperthyroidism (so-called secondary Basedow's disease) occurs after or in connection with other affections of the thyroid, such as simple and adenomatous goitre, cancer, and inflammations.

7. That there is a characteristic blood-picture in Basedow's disease which disappears after the surgical removal of a sufficient amount of the diseased thyroid tissue.

8. The successful treatment of Basedow's disease by measures directed toward the thyroid itself, as well as by serum therapy, proves the thyroid origin of the disease.

9. Basedow's disease can be cured by the surgical removal of portions of the gland in approximately 70 per cent. of all cases.

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A CHEEK DEFECT AND ITS REPAIR BY PLASTIC OPERATION.*

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HISTORY OF CASE.

A BOY, 16 years of age, was referred to me for treatment by Dr. John M. T. Finney. He was admitted to the Union Protestant Infirmary, January 25, 1912, suffering from a large defect involving entire thickness of the right cheek (Fig. 1).

The patient said that in February, 1910, he had a severe attack of typhoid fever, and was in bed about ten weeks. While he was in a comatose condition a small ulcer appeared on the inside of the right cheek, which spread and finally destroyed the entire thickness of the cheek. This was evidently *cancrum oris*.

When admitted there was a circular, funnel-shaped opening involving the entire thickness of the right cheek. The external diameter was 6.3 centimetres, and the internal was 3.8 centimetres. The defect extended from the level of the hard palate to the floor of the mouth, and from the ramus of the jaw to within half an inch of the angle of the mouth. The thickness of the posterior wall was 4.4 centimetres. The walls of the defect were made up of very dense scar tissue of woody hardness. The scar tissue also involved the adjacent soft parts of the cheek. Posteriorly, a thick column of scar tissue encroached upon the oral cavity, and this, with a smaller band anteriorly, seemed to bind the jaws together.

Both the upper and lower jaw bones on this side had evidently been involved in the destructive process, and were covered with dense scar tissue, which was continuous with the walls of the defect. The parotid duct could not be located. All the teeth were missing on the right side, excepting one or two incisors. The tongue, on this side, was closely adherent to the body of the

* Read before the Southern Surgical and Gynæcological Association, December 18, 1912.

lower jaw, and along the floor of the defect, to such an extent that, of the right side of the tongue, only the tip could be moved.

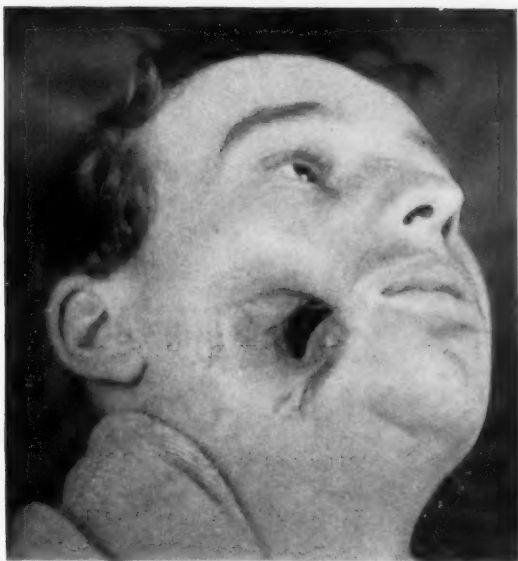
The patient was unable to open his mouth even with the greatest effort. This condition seemed due to the scar tissue, and not to any trouble with the joints, as a certain amount of joint movement could be demonstrated. All of the teeth were in bad condition. Articulation was very indistinct, and talking was impossible unless the opening was plugged with a dressing. The patient was obliged to force his food with his finger back behind the teeth on the left side, and was unable to feed himself through the defect, as the unequal movements of the tongue forced the food back through the opening.

After a careful study of the case I came to the conclusion that for the repair of this large defect a flap with a broad pedicle presented the greatest promise of success, as a good blood supply was imperative to combat infection and to nourish the flap until the new vessels from the surrounding tissues could take care of it. It was necessary that this flap should fulfil several conditions: (1) It should not contract appreciably after being implanted. (2) It should have enough thickness to fill the defect without causing a depressed area after healing was complete. (3) It should be formed of soft tissue (preferably fat, with whole thickness skin on both sides) which would conform in appearance to the surrounding skin externally and take the place of the mucous membrane in the mouth.

In order to avoid any further mutilation of the face or neck I determined to utilize the right arm, as I was able to secure a flap from this region which would fulfil every requirement.

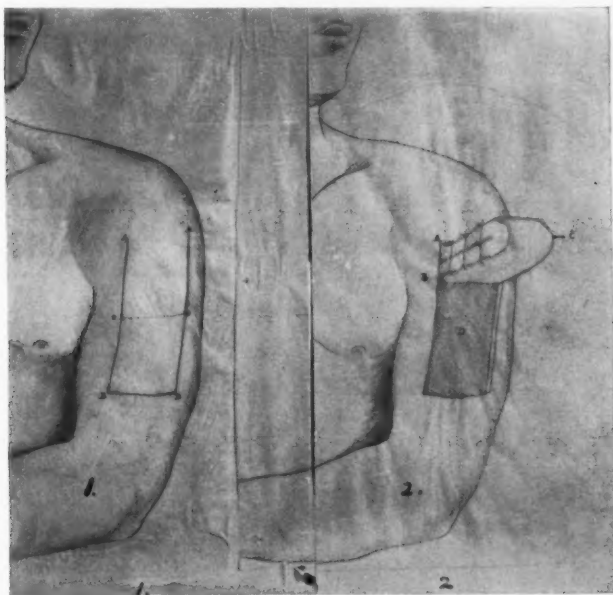
January 29, 1912.—*Operation:* Nitrous oxide-oxygen anaesthesia. A large pedunculated, rectangular-shaped flap 7.5 x 16 centimetres, made up of whole thickness skin, with its subcutaneous fat, was raised from the outer side of the right arm. The base of the flap was in the mid-deltoid region. The flap was folded on itself, and the distal end was sutured to the pedicle and underlying muscle. A few interrupted sutures were placed at intervals in the edges, thus bringing raw surface to raw surface, and forming a flap with a double thickness of fat within, and with whole thickness skin on front and back (Fig. 2). A number of small stab wounds were made in the flap to relieve congestion. The flap was then stretched by means of four

FIG. 1.



Defect in cheek before operation. Note depth of posterior wall and extent of scar-tissue involvement around the opening. The tongue can be seen adherent to the lower portion of the defect.

FIG. 2.



Schematic drawings, showing method of formation of flap. 1. Outline of flap. 2. The flap was folded on itself at *C*. The distal end *B* was brought up and sutured to the pedicle and underlying muscle at *A*. Several sutures can be seen holding the edges together and forming a flap with a double thickness of fat within, and whole thickness skin on front and back. The double faced flap was held flat on a wire frame. It was not transplanted until two weeks later, in order not to disturb the healing process between the raw surfaces, and to allow for shrinkage and the adjustment of the circulation. *D*, the area from which the flap was raised, was grafted immediately with Thiersch grafts from the thigh.

FIG. 3.



The flap healed into the upper portion of the cheek defect. Note the thickness of the flap and its excellent condition. Photograph was taken nine days after amputation of pedicle from the arm.

FIG. 4.



Result of operation. Photograph was taken December 2, 1912, six months after discharge. The defect is completely filled with a thick pad, which is level with the surrounding skin. The skin of the flap is soft, and of normal color.

sutures on a gauze-covered wire frame, to keep it flat and to control the contraction. Dressed with moist salt gauze. The area from which the flap was raised was grafted immediately with Thiersch grafts from the thigh. Silver foil, rubberized mesh, and dry gauze dressings.

February 11.—The flap was in excellent condition. There had been little shrinkage. The Thiersch grafts on the arm had taken *in toto*.

February 12 (fourteen days after the flap was formed).—*Operation:* Ether anæsthesia. As much as possible of the scar tissue was removed from the sides and upper portion of the defect. This was attended with considerable difficulty and much bleeding. The tongue, which was adherent almost to its base, was freed and drawn to the left side, and an attempt was made to close the raw surface. Even after dissecting out the scar tissue bands the jaws could not be opened to any extent, and this was probably due to the great infiltration of the muscles with scar tissue.

The flap on the arm was then opened across its free end and its edges freshened. The arm was raised into position and the flap was sutured into the defect. Catgut was used in the mouth and through the fat, and silk on the cheek. In this way the upper two-thirds of the defect was filled. The arm was then held by means of a plaster bandage, which also included the chest, shoulder, and head. The flap was dressed with moist salt gauze.

The patient was placed on a Gatch bed and every effort was made to keep him comfortable. Continuous salt solution by rectum was commenced and kept up for several days. Constant attention was given to the toilet of the mouth. Only sterile water was given by mouth until the third day, when nasal feeding was begun and continued until the pedicle of the flap was amputated. The nasal feeding was not commenced earlier, as vomitus would have been difficult to handle.

February 23 (eleven days after implantation).—The circulation seemed well established from the cheek. The flap had healed nicely, both inside and out. The cast was removed, and under local anæsthesia the pedicle was cut through close to the arm.

March 3.—There had been very little shrinkage of the flap since the last note. The general condition of the patient was excellent (Fig. 3).

March 4 (eleven days after amputation of pedicle).—*Operation:* Ether anæsthesia. The scar tissue was dissected out from the lower third of the defect, and, after trimming and freshening the edges of the flap, it was sutured in, so as to completely close the remainder of the opening.

March 18.—The healing, both within the mouth and on the cheek, was very satisfactory, except for a small sinus in the lower anterior angle of the flap, which did not connect with the mouth.

The tongue could be moved freely. Articulation was plainer and the patient could feed himself with more satisfaction than before the flap was implanted. In spite of as thorough excision of scar tissue as could be undertaken and closure of the soft parts, a dense band had re-formed at the anterior edge of the flap, close to the angle of the mouth. This seemed largely responsible for the inability to open the jaws.

March 27.—*Operation:* Ether anæsthesia. An incision was made through the angle of the mouth back to the scar tissue band, which was then excised. The anterior edge of the flap was loosened and sutured to the mucous membrane. As much as possible of the remaining scar tissue was excised or divided, but the involvement of the deep tissues of the cheek did not allow much jaw movement. The angle of the mouth was closed. The jaws were held apart by a wooden wedge forced between the teeth.

April 4.—Some progress had been made in opening the jaws by means of wedges, but this could not be forced on account of great soreness of the teeth. Injections of fibrolysin were begun in hopes that it might have some softening effect on the dense scar tissue, and these injections were continued daily until 26 doses had been given. No softening effect was noted. During the healing there had been a contraction of the scar tissue in some places around the flap, causing a depressed scar.

May 20.—*Operation:* Ether anæsthesia. The depressed scar was excised, and at the same time a further effort was made to loosen the jaws by dividing scar tissue, but with little success.

June 2.—Patient discharged. *Condition:* General health excellent. The defect was entirely closed with a thick flap which was nearly level with the surrounding tissues. There was wonderful improvement in the appearance of the patient. The

flap was in excellent condition. The skin was soft and pliable and of normal color. Within the mouth the skin was whitish and soft, and seemed to be gradually taking on the characteristics of the mucous membrane. It had united as satisfactorily to the surrounding tissues as had the external layer. The jaws could be opened so that the tip of the finger could be introduced between the incisor teeth, and there was considerable lateral motion. There was free motion of the tongue. The boy could talk much plainer than when admitted, and the feeding process was simplified.

The courage and cheerfulness of the patient helped materially during the tedious treatment.

Remarks.—The general physical condition of the patient was of the utmost importance, and rest, fresh air, forced feeding, and tonics were resorted to. In addition, particular attention was given to the cleanliness of the mouth, and the services of a dentist were obtained. Nasal feeding was inaugurated after each operation involving the mouth cavity, and I wish to emphasize the importance of this method of feeding in similar cases, as feeding by mouth while the wound is fresh adds materially to the chance of infection, especially where there is so much difficulty in keeping the mouth clean.

On several occasions systematic attempts were made after dividing or removing the scar tissue to force the jaws apart by means of mouth-gags, wooden wedges, and screws, but they were only partially successful.

In a cursory glance through the literature I have not encountered just this method of utilizing the "flap from distant part principle" for closing a cheek defect.

The operations of Israel,¹ Hahn,² and Czerny³ are the only ones, as far as I can find, in which a portion of the same whole-thickness pedunculated flap is utilized to close both the defect in the mucous membrane and also in the skin. Israel secured his flap from the neck, Hahn from the chest, and Czerny from the cheek and neck.

All methods of closing such defects are tedious in their accomplishment, and this method is no more so than the

others, and has, I think, advantages which make it desirable.

By the method of treatment used in this case the defect was filled with a thick flap of tissue with whole-thickness skin on both sides. The circulation of the flap was assured before the transplantation was begun. Most of the shrinkage of the flap had taken place before it was transplanted. There was no unsightly scarring of the cheek or neck. The area from which the flap was raised was entirely healed by means of Thiersch grafts by the time the flap was ready for transplantation, and thus one chance of secondary infection was eliminated.

The only serious disadvantage of the method is the constrained position of the patient during the time the circulation from the cheek is entering the flap. This position apparently causes little discomfort after the first 48 hours. This patient did not even complain of soreness in the shoulder after the pedicle was amputated and the arm lowered to the side.

In a letter of recent date the patient says he is attending school and doing well. His appearance is so much improved that it causes him no concern. He can eat with comfort and pleasure, and is able to talk much plainer than before operation (Fig. 4).

On the whole the result is very satisfactory, although there is still limitation of the jaw movement. Furthermore, and most important, is the fact that the patient is relieved of a hideous deformity, which would have prevented his living a comfortable, healthy life, and would probably have interfered with his obtaining lucrative employment.

¹ Israel, J.: Arch. f. klin. Chir., Berlin, Bd. 36, 1887, S. 376.

² Hahn, E.: Verh. d. Deutsch. Gessellsch. f. Chir., 1887, 1, S. 102.

³ Czerny, V.: Beitr. z. klin. Chir., Bd. 4, 1889, S. 621.

TEMPORARY ARREST OF THE HEART BEATS FOLLOWING INCISION OF THE PERICARDIUM FOR SUPPURATIVE PERICARDITIS.

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No doubt, the rarity of an operation for suppurative pericarditis is sufficient to warrant its reporting. But, in addition to the surgical interest of this condition, the observation noted during the operation is a further reason for publication. This particular observation—temporary arrest of the heart on incision of the pericardium—may have a physiological significance, the importance of which, perhaps, has not been understood in the past, and the recognition of which may influence, in the future, the development of the technique of cardiac surgery.

The patient whose history is detailed below entered the Second Surgical Division of Fordham Hospital, in the service of Dr. William P. Healy, to whom the writer is indebted for the privilege of operating on and reporting the case.

History: The patient, a thin, poorly-nourished, anemic child, aged 11 years, was admitted September 10, 1912, to the Medical Ward of the Fordham Hospital, and on the same date transferred to the Second Surgical Division. Present illness began one week ago. Complained of pain in the left thigh, which has persisted. Swelling of the left thigh. No chill. Slight elevation of the evening temperature.

When admitted her pulse was rapid, weak, and irregular. Heart sounds weak and distant. Dulness, bronchial breathing, increased fremitus, and moist râles at left apex. Numerous moist and crepitant râles over left chest. Dulness, decreased fremitus, and diminished voice and breath sounds at base of left lung. Intensified breathing over the entire right lung.

Her abdomen was moderately distended. No mass can be felt. Liver, spleen, and kidneys not palpable. The left thigh is swollen, red, and tender. Deep fluctuation can be elicited. Temperature, 100 2/5. Pulse, 126. Respirations, 24.

Soon after the patient had been transferred to the surgical ward, the left pleural cavity was tapped and six ounces of turbid fluid obtained. A microscopical examination of this fluid revealed some pus-cells. No tubercle bacilli and a few Gram-negative staphylococci.

September 11, 1912.—General condition is somewhat better. The heart action is much embarrassed, the sounds being almost inaudible. A hypodermic needle was inserted into the pericardial sac and thirty minims of turbid serum obtained. Microscopical examination showed no tubercle bacilli. A cytological count showed polymorphonuclears, 49 per cent.; large lymphocytes, 33 per cent., and small lymphocytes, 78 per cent. The culture plates were contaminated. There was subsidence of the swelling of the thigh, though tenderness was marked. Temperature, 100 to 102. Pulse, 112 to 130. Respirations, 28 to 40.

September 12.—The cardiac impulse is neither visible nor palpable. Percussion shows the left border of cardiac dulness 11 centimetres from the midsternal line. Dulness is also increased to the right of the sternum. The sounds are more regular, though still muffled. Flatness and absent breath sounds over the base of the left lung. Increased breath sounds over left apex. The left leg is slightly cyanotic and the thigh swollen and tender. Temperature, 100 to 100 4/5. Pulse, 104 to 120. Respirations, 24 to 32.

September 13.—*Operation* (Dr. W. P. Healy): Incision and drainage of subperiosteal abscess of left femur. Ether narcosis. A vertical incision made on the inner aspect of the left thigh, a short distance above the knee-joint. The incision was deepened and a purulent collection encountered near the shaft. The bone was smooth and intact. Six packs of iodoform gauze were inserted and a dry dressing applied.

During the succeeding ten days the thigh wound drained freely. Her cardiac condition remained without improvement, with a tendency to become more accentuated.

September 25 (twelfth day *post operationem*).—The heart sounds are almost inaudible. The pulse rapid, weak, and irreg-

ular. There is dulness over the left lung posteriorly. The area of cardiac dulness is markedly increased. It is evident that there is both a pericardial and pleural effusion. Temperature, $100 \frac{3}{5}$ to $102 \frac{1}{5}$. Pulse, 118 to 130. Respirations, 28 to 40.

September 26.—Dr. A. F. Brugmann, after examining the patient, advised, as a preliminary measure, aspiration of the left pleural cavity.

This was done and twelve ounces of blood-stained fluid obtained. Slight improvement followed, but the cardiac embarrassment still persisted. Temperature, 100 to $101 \frac{4}{5}$. Pulse, 92 to 132. Respirations, 30 to 56.

September 27.—Condition is poor. The pulse is very weak and irregular. Dyspnoea upon the slightest exertion. Extremities cold and cyanotic. Temperature, $100 \frac{2}{5}$ to $100 \frac{4}{5}$. Pulse, 98 to 134. Respirations, 40 to 60.

September 28.—Condition same as day before. Temperature, 100 to 102. Pulse, 130 to 160. Respirations, 44 to 66. The patient was brought to the dressing-room and the pericardial area painted with iodine; a medium-sized trocar and cannula were introduced into the pericardial sac, the point of entrance being in the left fifth interspace, one and one-half inches from the sternal border. Upon withdrawal of the trocar, purulent fluid was ejected under considerable pressure. Three ounces had been obtained when the flow ceased. It was apparent that more than simple aspiration was needed, hence operation was decided upon. The patient was returned to the ward and the operating room prepared.

Operation (Dr. A. H. Harrigan): Ether-oxygen narcosis. Dorsal position. The incision was four inches long. It began at the left sternal border and passed obliquely downward and outward, crossing the left costal cartilage at its centre. One and one-half inches of the fifth rib and cartilage were removed with the bone forceps. When the anterior mediastinum was opened several loud, hissing noises demonstrated that there had been an accidental laceration of the pleural reflection. A gauze packing was placed in the outer angle of the wound to prevent further entrance of air into the pleural cavity.

The pericardium was at least two inches distant from the surface of the chest. It appeared thickened and covered with a semi-gelatinous material. Several attempts were made to grasp

the pericardium with hæmostats so as to steady it before incision. Each time the hæmostats slipped. Finally, however, control of the membrane was secured and an incision two inches long made in the pericardial sac. Immediately upon opening the sac a large quantity of pus was forcibly ejected with a gush, forming a stream the height of which was at least two feet above the level of the patient. (Culture of this fluid showed staphylococci.)

Following this, the phenomenon mentioned in the title was noted. *The heart deeply placed within the pericardial sac lay absolutely motionless. No movement could be seen or felt. At the time of this observation an assistant palpating the radial artery could obtain no pulse. It was not determined whether the heart was in systole or diastole. The duration of this cessation of the cardiac action was not timed. Finally, when an attempt to introduce a gauze drain into the pericardium was made, the heart began to beat, and within a minute the action became tumultuous, causing the organ to spring forcibly against the chest wall.* After the introduction of the drain a voluminous dressing was applied and the patient returned to bed. The patient quickly recovered from the anæsthetic. During the remainder of the day and night the condition was satisfactory. The pulse was rapid but strong. Some restlessness at night required morphine. There was dyspnœa upon exertion. Camphor and digitalis administered.

September 29.—The external dressings were removed. They were saturated with thin, yellow pus. An examination of the drain and wound showed no blocking. Fresh dressings were applied. The camphor was discontinued and whiskey added to the digitalis. Her condition was the same as on the day of operation.

In the evening of this day the child's parents became very much alarmed about her condition and decided to move her to her home. This decidedly rash action met the earnest protestations of the house staff, but to no avail. Her parents moved the patient from the hospital to her home in the lower East Side of New York, a distance of at least nine miles, and among conditions decidedly prejudicial to her recovery. After staying there two days she was sent to Bellevue Hospital, where she died forty-eight hours after her admission.

In the absence of an autopsy it is impossible to speak

decisively as to the exact condition present. Reasoning, however, from the chain of clinical findings, it is extremely probable that the primary condition was a subperiosteal abscess of the femur, and the pericarditis was secondary, as the result of general sepsis. It is certain that the fatal outcome was hastened and perhaps aided by the premature removal of the patient during the most critical period of her illness. Possibly an earlier operation would have offered better prospects. A lesson learned from the study of this case is to use the exploring needle repeatedly as a diagnostic method if these cases are to be operated upon at a favorable period.

The fluid present, while not measured, easily amounted to a quart. The height to which it attained at the liberation indicated the extreme degree of intrapericardial pressure. That the pericardium may contain a large amount of fluid is explained by the softening produced in its walls by the inflammatory process. The sac, though normally resistant and elastic, becomes quite distensible.

The method of operative attack employed—simple resection of the fifth rib and cartilage—presents two disadvantages. The first is the indirect course of the drainage track, and the second consists in the liability of injury to the pleura. As a result of this technique, the resultant line of drainage passes from the pericardium obliquely forward and outward. This is objectionable. As mediastinitis is a frequent complication of suppurative pericarditis, it seems as though drainage directly forward through the mediastinum is indicated. Pleural injury seems extremely likely, for many of those who have studied the topography of the thoracic viscera (Dwight, Delorme, Sick, Quain, and Testut), agree that the reflection of the pleura and of the pericardium varies in many instances. An excellent discussion of the many operative procedures to expose the pericardium may be found in the monograph of Delorme and Megnoir.

Considerable discussion has centred around the relative position of the heart in the presence of a pericardial effusion.

In this instance the heart occupied a posterior position. This observation agrees with that of Eichel.

The striking feature of the operation was the peculiar and wholly unanticipated behavior of the heart when the pericardium was incised. The persistent "Stillstand" was indeed surprising. In order to determine whether this observation has been previously described, many case reports of operations for suppurative pericarditis as well as gunshot and stab wounds of the heart have been investigated. In several the reporters mention casually that a disturbance in the cardiac rhythm occurred when the heart was exposed; but none offered any explanation or even suggested that its occurrence may rest upon a definite physiological basis. In this regard the work of Heitler and Flint is of prime importance.

In 1910 Heitler published a *résumé* of his animal experimentation performed in Basch's Laboratory in Vienna. His article appears in the *Medizinische Klinik*, and is entitled: *Herzstörungen durch Reizung des Perikards. Vorschlag zur Kokainisierung des Perikards bei Operationen am Herzen*. Heitler noticed that as a result of electrical or mechanical stimulation of the pericardium in dogs marked irregularity in the beat of the heart occurred. Without detailing his experimental studies *in extenso*, it may be said that Heitler arrived at the definite conclusion that stimulation of the pericardium caused arrhythmia. In addition, he drew the deduction that the cardiac irregularity seen during the progress of pericarditis had its origin in irritation of the pericardium. Moreover, he recommended in operations upon the heart cocainization of the pericardium, preliminary to its incision, in order to prevent consequent interference with the heart action.

Heitler constantly uses the word arrhythmia in describing the phenomena noted. This term, of course, is vague, and offers no suggestion as to what mechanism or nervous reflex is disturbed. Heitler makes no attempt to explain the arrhythmia in the terms of the modern heart physiology.

Flint, in an article entitled "Physiologic Basis of Thoracic Surgery," confirms Heitler's work, but, in addition, maintains

that the arrhythmia is caused by a vagus reflex. Flint sums up thus: "The manipulation necessary for the incision of the pericardium manifests itself with perfectly typical cardiac inhibition, which lasts as long as the irritation of the pericardium continues."

As a matter of historical interest, it is significant to find that Ranvier, in his *Leçons d'Anatomie générale*, which appeared in 1880, refers to a contribution by Engelmann, published in 1875, describing the following experiments by Tagliani: The heart of a frog was stripped of its visceral pericardium, and it was then found that the myocardium no longer contracted on being touched with a needle on its denuded portion; it did contract, on the contrary, when it was stimulated at the points where the pericardium was preserved. Tagliani explained this observation by the presence of sensory nerves in the pericardium, the stimulation of these nerves acting upon the centre which produces the movement.

Engelmann repeated these experiments and arrived at different results. The interpretation of Tagliani was regarded by Ranvier as erroneous. However, in view of our present knowledge, the original observation of Tagliani as to the physiological relations existing between the pericardium and the myocardium apparently contained a germ of truth.

As a result of a study of the above references, it seems logical to assume to state that there exists a physiological association between the pericardium and myocardium, and that stimulation of the former causes a disturbance in the rhythmic activity of the heart. The exact relationship is unknown. In view of this, it seems fair to assume that the "Stillstand" of the heart noted at operation was caused by irritation—incision or manipulation—of the pericardium. It is apparent that the entire subject requires further investigation.

If this relationship between pericardium and myocardium be definitely established, then it will be necessary to revise the present technique of cardiac surgery.

MEMBRANOUS PERICOLITIS AND ALLIED CONDITIONS OF THE ILEOCÆCAL REGION.

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To every surgeon probably has come once or oftener the humiliating experience of operating upon a patient for what he had carefully diagnosed as chronic appendicitis, only to find, after removal of the appendix, that the symptoms persisted without improvement. Ofttimes the primary operation has been supplemented by a drainage of the gall-bladder or, if the patient be a woman, by the removal of an ovary. And still the patient experienced no relief. Somewhat similar experiences have followed the surgical history of supposed gastric ulcer where gastro-enterostomy, in the absence of demonstrable pyloric obstruction, has proved so disappointing. To palliate our failures in these operations about the appendix, gall-bladder, and stomach we have been wont to fall back on the all-embracing diagnosis *neurasthenia*, which enabled the surgeon to smoothly edge from under the load of responsibility, but left the patient hopelessly mired in the slough of despond.

Such experiences naturally have been exceedingly distressing to the conscientious surgeon and have correspondingly stimulated our zeal in efforts to avoid similar errors and, better still, to discover some solution of our dilemma. Closer observation of pathological conditions, wider investigation of the accessory surgical field, and more exacting analysis of symptoms have thus become imperative. And to-day we are beginning to reap the fruit in the definition of other lesions which explain our former errors of diagnosis and point the way to possible rescue from despair of many of these unfortunates.

MEMBRANOUS PERICOLITIS.

In 1908 the writer presented to the Western Surgical Society some observations on certain pathological changes found about the right colon to which he applied the descriptive name "Membranous Pericolitis," or the "Pericolic Membrane." These conclusions were the culmination of isolated individual observations of about six years. The first observation was made in 1902 in a case with the following history:

The patient was first seen by us when she was a probationary nurse in the University Hospital of our city several years before. We were then consulted for what was supposed to be an acute exacerbation of a long-standing case of chronic appendicitis. She gave the history of a number of previous attacks. In each case she had suffered from pain and distress over her entire right abdomen, though more particularly referred by her to the site of the appendix. In none of these attacks had she had temperature or pulse disturbances,—in fact, none of the characteristics of an acute appendicitis or peritonitis. She had gone to bed, however, frequently for a day just from pain and discomfort. She said that she had never felt entirely comfortable in her right side for years, but did reasonably well except when these severer "spells" came on. She was a very attractive young woman in her personality, and quite intelligent, though of a decidedly high-strung temperament and somewhat neurotic. She described her symptoms very freely,—in fact, was more fluent than is the average woman in portraying her complaints. We found her with a normal pulse and temperature. On palpation she complained of tenderness all over the right abdomen, was indeed quite hyperæsthetic. There was no rectus rigidity. Her greatest tenderness she located about the appendicular region in general, but we could not focalize to a finger-point. We fell in quite readily, however, with a diagnosis of chronic recurrent appendicitis and recommended operation upon her recovery from this "spell." There was no suggestion of urgency. When she got up, however, still being a probationer, the superintendent of nurses decided not to accept her in training, as she considered her too neurotic to make a satisfactory nurse. She therefore left the hospital, and we did not see her again for three or four years. She then came to Kansas City from her home in Iowa, where she had married and then lived, to consult us again. We then learned that in the interval she had been operated upon by a distinguished surgeon, whom we knew, and had had her appendix removed. She obtained no relief from the operation, however, and continued to suffer as before. A second operation was done and one of her ovaries removed. Still no relief, and with this history she returned to us. On examination, with the appendix and one ovary gone, we could find no explanation for her continued symptoms. She was

therefore referred to one of our leading internists, who sent her back again, saying that the other ovary was diseased and should be removed. We could not confirm this diagnosis, but she insisted on relief, and we consented to operate on the diagnosis of our medical *confrère*. Operation disclosed the one remaining ovary perfectly healthy. A perfectly healthy broad ligament was found on the side from which the ovary had been removed. We then decided to inspect the site of the appendix. Here we found a perfectly smooth cæcum at the site where the appendix had been with not the slightest adhesion of any kind. Above the appendix, however, indeed, really above the cæcum about the colon our attention was strikingly attracted to the condition with which this paper is concerned. Here we observed what looked like an entirely complete new layer of peritoneum, perfectly transparent, investing the colon from above the cæcum to the hepatic flexure. This membrane was very loosely attached, but moved freely over what appeared to be the normal peritoneal coat of the colon beneath. This membrane appeared to come on to the colon from the outer parietal wall, into which it quietly faded away and, above the hepatic flexure of the colon, became lost in the transverse mesocolon. The membrane covered also the whole of the circumference of the colon and imperceptibly became lost in the inner side of colon and the inner parietal peritoneum. The whole right colon was rather closely confined in the lumbar fossa and could not readily be pulled forward. Likewise it seemed distinctly shortened in its long axis and at places presented a pleating, with the delicate fibrous strands of the investing membrane passing straight across from one fold to the other. It thus appeared as though the colon was restricted both as to the action of its circular and its longitudinal fibres and more or less immobilized to the posterior abdominal wall. There were no adhesions between the colon and any contiguous structure, and the membrane did not strike us as analogous to an adhesion in any sense. It looked instead as we have described, as a new adventitious, vascularized, investing layer of peritoneum. At the time of this, our first, observation it impressed us as some sort of an anatomical freak which we in no way associated in our mind with the woman's complaints. We made no attempt, therefore, to deal with the membrane in any way, and, with the simple observation of its peculiar appearance, closed up the abdomen. The patient was, of course, not improved in the least by our operation, though we were satisfied now with a diagnosis of neurasthenia, and placed her malady in her head and not in her abdomen.

In the course of years, both before and since this case, we can recall several cases of somewhat similar clinical picture in which we have operated with a diagnosis of chronic appendicitis and removed the appendix—but without the expected relief to our patient. These cases, being always considered uncomplicated chronic appendicitis, were operated with a very

small abdominal incision, and the colon was not seen at all. The real condition in these cases is as yet conjectural, as we have had no opportunity to re-operate in any of them. In the light of other demonstrated cases, however, we now have a strong suspicion that this same pericolic membrane could be found in at least several of them.

Following this interesting case, however, we operated in several cases of somewhat the same type, and with the diffused symptoms were in doubt as to whether the trouble lay in the appendix or the gall-bladder. In several such cases, in order to expose both sides through one opening, we made a free right rectus incision midway which could be enlarged in either direction as found necessary. This incision thoroughly exposes the ascending colon. In several of these operations we found both appendix and gall-bladder perfectly normal, but, to our surprise and interest, again observed this same peculiar membrane.

In review of these several observations we became convinced that herein lay a certain very absolute pathological condition of more or less frequent occurrence. We were sure that similar observations must have fallen under the eye of practically every surgeon of any considerable experience, though none, so far as we knew, had given it any special consideration in pathological description nor recognized it as a condition of any common occurrence or clinical significance. The only article bearing on this subject which had come under our attention was a brief one by our fellow-surgeon, Binnie, on "Pericolitis Dextra," undoubtedly referring to the identical condition, but viewing these changes simply as adhesions, as doubtless had the other many observers. This general conception had led to rather cursory attention, with the general assumption of antecedent appendicitis and the hope of relief by ordinary appendectomy. In our opinion, however, we had to deal with a condition of rather more definite pathological specificity, the exact origin and nature of which should become a matter of moment.

Pathological Description.—In 1908, at the Kansas City

General Hospital, we were fortunate enough to find a well-marked case in a patient dying of other causes, but with history of this type. This specimen was removed and submitted to careful examination by the pathologist, Dr. Frank J. Hall, who reported as follows:

"The specimen of ascending colon which you presented to me as a type of the pericolicitis you have been interested in exhibits the following gross and microscopic features: The specimen presents the caput coli with attached appendix, the ascending colon, and a short segment of the transverse colon.

"From a point just at the hepatic flexure to three inches above the caput there spreads from the parietal margin over the external lateral margin to the internal longitudinal muscle band a thin vascular veil in which long, straight, unbranching blood-vessels course, most of which are parallel with each other and take a slightly spiral direction over the colon from the outer upper peritoneal attachment to the inner lower portion of the gut, ending just above the caput. The appendix is not implicated in any way.

"Coursing with the blood-vessels are numbers of shining, narrow bands of connective tissue which gradually broaden as they go and end in a slight, fan-shaped attachment at various points on the anterior and inner surfaces of the colon. At these points of attachment the gut is held in rigid plication.

"The entire specimen conveys to the eye the idea that an œdematous fluid lies beneath this delicate membrane and reminds one of nothing so much as an œdematous arachnoid so often encountered on removing the dura mater from the brain of a dead alcoholic. The colon seems placed in a diaphanous bag slightly too short to contain it without wrinkling. At the beginning of the hepatic flexure the drawn membrane particularly angulates the contained tissue. Here and there are spots and tags of fat beneath the cobweb. On handling the specimen the colon slips about in its bag without entire freedom as a fetus within its amniotic sac. A portion of the parietal peritoneum has been removed with the colon, and shows that the membrane and blood-vessels arise in, and are continuous with, the structures of the parietal peritoneum as it sweeps over the colon. The entire structure seems to be peritoneum, loosened from its close connection to the abdominal wall and colonic surface by some serous exudate, after which the particular vascularization and connective-tissue banding has occurred as a chronic reaction to irritative influence.

"Microscopic sections prepared from blocks of tissue cut entirely through to the lumen of the colon present, first, a very loose external covering, a normal musculature, a broad submucosa, and a normal glandular coat. Our chief interest lies in the serous coat, which is seen to have its fibres split asunder as if by serous infiltrate, thus lifting the endothelial layer of the membrane, which is clearly demonstrated to exist as a cover-

ing for all. The blood-vessels present in cross section and are unusually large and thin walled. Wherever a blood-vessel courses there also is a condensation of the white fibres into bands parallel to the vessel. The general aspect of the region under discussion is that of a mass of more or less isolated fascicles of white fibrous tissue, with here and there a blood-vessel filled with blood, broad clefts lined with endothelium, and a few fat and connective-tissue cells sprinkled here and there.

"No fibrin, polymorphonuclear leucocytes, or other evidence of inflammation are present. The connective tissue next to the layer of longitudinal muscular coat is condensed, and seems to penetrate in increased amount between the muscle bundles. Aside from this questionable matter, the gut and its walls are normal. The endothelial covering in places on the surface is perfectly preserved, and demonstrated beyond a doubt that we have here no new or false membrane, but simply a rarefied and otherwise altered natural structure. The enlargement of the endothelial-lined clefts so abundantly observed suggests a chronic lymph-stasis as an associate condition, which is possibly a key to the formation of the amount of fluid in the tissue spaces of the peritoneum."

Clinical Description.—In addition to this description we would add some observations of the condition as observed now in quite a number of living subjects seen in the course of surgical operations. The transparent, vascularized veil appearance of the membrane strikes one's attention very forcibly with bright red vessels running parallel with the long axis of the ascending colon. In some instances it appears as though the membrane came on to the colon from the lateral parietal wall just above the cæcum and courses directly upward, to disappear beneath the liver on the superior layer of the transverse mesocolon. In other instances it seems attached to the under surface of the liver well anterior to the normal peritoneal reflection. Again, in other cases, it appears as though it had begun above and descended on the colon to its termination usually just above the cæcum.

Again we have seen it pass across and upward to the transverse colon, which in one instance was apparently drawn down by the membrane, practically paralleling the ascending colon to the level of the cæcum. (In this case the gastric symptoms were marked as a result of the mechanical gastropnoia thus produced.) In one instance this membrane was so dense as to lose entirely its apparent vascularity and transparency, and

looked like a solid sheet of organized fibrous tissue, beneath which the ascending colon was so lost that it could not be seen at all until the membrane was divided and brushed aside, when an apparently normal, though contracted, colon became evident. In one instance the membrane, passing from the colon across the posterior parietal wall, went as far over as the jejunum, which was likewise completely invested for about eight inches of its distance immediately after its beginning beneath the transverse mesocolon. In this case the symptoms had been quite strikingly those of pyloric stenosis, which was the pre-operative diagnosis.

In no instance does this membrane resemble our ordinary conception of an adhesion. It is never adherent to the abdominal wall nor to any contiguous loops of small intestine. Instead, it resembles more closely than anything we can describe a thin pterygium. In recent cases the membrane is quite free and produces but limited restriction to the underlying colon. In more advanced and characteristic cases it seems to bind the colon close to the posterior abdominal wall, and produces such marked angulations and convolutions of the colon as to practically produce a stricture of its lumen. In fact, in one of these cases seen in autopsy, when a stream of water was caused to flow into the cæcum through the ileocæcal valve, the cæcum distended almost to bursting, and yet none of the fluid would pass through the ascending colon and pass the hepatic flexure until it was milked through with the fingers. It is also noteworthy that in the large majority of cases the cæcum was not involved in the membrane at all, but is found greatly distended and correspondingly thin. Nor was the appendix invested except when it occupied an ascending position at the outside of the colon, when it was covered by the membrane as it was reflected on to the colon from the lateral parietal wall. The appendix in almost every case, however, was rather small and sclerotic. We have seen the membrane in one case in which there had been years before an appendicular abscess which was drained. In this case the cæcum was likewise markedly involved in the membrane. The angulation of the

colon is generally most marked at the hepatic flexure. There is always a very loose space where the membrane can easily be picked up at the outer angle where it passes from the colon to the outer parietal wall.

Etiology.—The cause or origin of this condition has given rise to considerable speculation, with a number of quite diverse theories. These varied theories resolve themselves naturally into three general theories: (1) congenital, (2) mechanical, (3) inflammatory, each with certain minor differences.

1. *Congenital.*—Quite a number of observing surgeons have expressed the view that the membrane described is congenital in origin, but differ as to the exact anatomical derivation.

(a) Mayo is inclined to view this membrane as the true peritoneum, which, as the cæcum descends, failed to settle itself closely in the normal way to the gut-wall, but, remaining loose, acquired the peculiarly excessive vascularization. If this were correct, we would wonder why similar peritoneal laxity did not extend to the cæcum as well.

(b) Keiller of Galveston, in personal conversation, suggested the possibility that this membrane was a prolongation of the border of the great omentum which became attached to the ascending colon while it was still up beneath the stomach before complete rotation and was drawn down over the gut in its descent and remained as a separate layer of peritoneum. His view was suggested by the parallel arrangement of vessels as in the true omentum and the fact that it appeared so often to come on to the ascending colon from above and was practically continuous with the right border of the true omentum. This theory has recently been supported in print by Cotte of Lyons, France, who considers it as *one* of the types of membrane. In cases, such as our first and others reported (one by Pilcher), where the descending portion of the transverse colon is drawn down parallel to the ascending colon and mutually covered by this membrane (double barrel, as Gerster describes), the suggestion looks plausible. We also have recently observed a case in which

the lower portion of the usual omentum was fused with the pericolic membrane for a width of about two inches just above the ileocæcal juncture, presenting a definite band of constriction, but free above entirely.

These congenital theories are attractive, and at the same time would offer the greatest encouragement to surgery. For, if such they be, a simple division of restricting bands, like tenotomy in congenital club-foot, should furnish relief, as should the method suggested by us in our original paper. However, so far we know of no observations of this condition in infancy or childhood. Furthermore, in all our cases the clinical history has been of adult origin. Perhaps, however, this can be explained by assuming that in early growth of the gut the membrane is sufficiently lax to permit freedom of peristalsis. Later on, however, as the gut grows in length or is lengthened by traction of the weight of stagnant feces, the membrane fails to stretch correspondingly, and hence begins to become a source of restriction and obstruction. Then follow the clinical phenomena.

(c) We have noted as one of the attendant conditions of our pathological picture the great dilatation, elongation, and thinning of the cæcum. As far back as 1904 Wilms of Germany called attention to a condition characterized by great motility and elongation of the cæcum, to which he applied the term "Cæcum Mobile," and to which he ascribed a chain of symptoms quite like those we have found in membranous pericolitis. This condition of the cæcum is generally congenital, and, if the symptoms in our cases are due to the condition presented by the cæcum alone, we should recognize here likewise a congenital origin. Dreyer (Breslau), however, in anatomical studies found the cæcum freely movable in as large as sixty-seven per cent. of subjects, and hence questions the mobile cæcum in itself as a factor of much importance. In our observations we have been inclined to consider the enlargement of the cæcum as a secondary change, its gradual dilatation being the result of long-continued distention by gas and feces which are retained in the cæcum

owing to the obstruction in the colon above, caused by the restrictions of the pericolic membrane. Wilms, however, claims the existence of a symptom producing mobile cæcum without membranes, adhesions, or kinks. Such must be rare in our observation.

2. *Mechanical*.—All are familiar with the noteworthy and frequent papers of Arbuthnot Lane of London on "Chronic Constipation" and "Chronic Intestinal Stasis." Beginning with intestinal stasis, primarily dependent upon transition in man to the erect posture with evolutionary social changes and habits favoring stasis, Mr. Lane traces an extraordinarily interesting chain of sequences, both pathological and clinical. Among these pathological changes he describes adhesions about the terminal ileum, appendix, ascending colon, the hepatic and splenic flexures, and the sigmoid, all of which he considers as accessory ligaments formed to antagonize the downward strain, with tendency to prolapse of these segments of the intestinal tube. These adhesions, as described by Mr. Lane, are intended to be conservative and protective, though he admits they sometimes go too far and become obstructive. American observers have confirmed Lane's observations, practically concerning the kink (Lane's kink) near the terminus of the ileum and the adhesions (if such they be) about the ascending colon and hepatic flexure. His more elaborate or extensive descriptions have not often been verified, however, in this country. We are of the opinion, however, that what he has described simply as "adhesions" is, in fact, the same condition we have endeavored to present, though his observations have evidently been very lacking in descriptive significance and clarity. Likewise, while simple intestinal stasis may act in some manner as a cause in the production of these "adhesions," it is the "adhesions" which produce the suffering. Likewise, it may be pertinent to inquire if the "adhesions" may not, instead, be or become the cause of the stasis. At all events, we are persuaded that something definitely more than chronic constipation must exist to occasion either the pathologic or the clinical picture presented by

membranous pericolicitis. For all have seen the most stubborn and complete cases of constipation with no such pathological picture at all and oftentimes without any further clinical symptoms. We think this membrane is therefore something other than physiologic response to mechanical demand.

3. *Inflammatory*.—Two general theories of the origin, based upon the assumption of inflammatory origin, have been presented, one assuming a spreading peritonitis from points of original infection *without*, and the other a reaction from infection *within* the *contiguous* gut.

(a) *Without*.—Undoubtedly our older views of this condition accepted it as one of true adhesion, the result of old infection transmitted from, most usually, the appendix, or, in case of particular involvement about the hepatic flexure, from the gall-bladder; and upon this hypothesis it was confidently expected that the simple removal of the appendix or the drainage of the gall-bladder would suffice to cure. This surgical effort has proved a failure. This failure, however, does not suffice to disprove the theory, as the "adhesions" which are the effect of the original disease may suffice to become a secondary and effective cause of their own train of symptoms, and, even though the original focus is removed, this secondary cause remaining now becomes a primary source of importance. Hertzler, who also made microscopic examination of specimens from some of our earlier cases, believes the condition one of "varicosity of the peritoneum," due to a more or less distant inflammation, and that the membrane ("pseudo-peritoneum") itself consists of peritoneum mobilized by a hyaline degeneration of the subperitoneal connective tissue. The clinical history, however, does not show in these cases any sufficient evidences of a true peritonitis originating from a focus which would produce such broad results, apparently.

(b) *From Within*.—Perhaps the majority of surgical observers have held to the view that the peritoneal reaction is from infection within the colon. Gerster concludes that "the peritoneum reacts to the infectious process ordinarily associated with *chronic colitis* by the formation of character-

istic vascularized transparent membranes (pseudo-peritoneum) which take their origin along the external lateral aspects of the cæcum, ascending colon, and hepatic flexure on the one side, and the sigmoid flexure, descending colon, and splenic flexure on the other."

Pilcher, likewise, "considers them to be *the result of long-continued or oft-repeated mild infections of the peritoneal covering of the cæcum and appendix* transmitted through the intestinal wall," but does not specifically presume a colitis, as does Gerster.

The pathological report of Dr. Hall, quoted earlier in the paper, finds no microscopic evidences of change in the mucous or submucous coats to conform with the true colitis. When we reflect that the area of gut most affected is that from which most of the *physiologic absorption* takes place in the normal tube it is not difficult to assume that through this segment mild infection and toxins may likewise pass to the peritoneum without necessarily concomitant inflammation of the mucous lining, though the latter may, and doubtless often does, coexist. M. L. Harris is a positive advocate of the inflammatory theory, and believes that the anaërobic bacteria described by Runeberg and Keyde, which are always resident in this portion of the intestinal canal, are the specific factors in the production of the peculiar vascularizing inflammation characteristic of this pericolitis.

Our personal observation of now a considerable number of cases at operation rather inclines us to the belief that perhaps varied causes may be responsible for the production of this pericolonic membrane. We have one case, previously reported, in which the membrane (in this case involving the entire cæcum as well) was undoubtedly the sequence of an antecedent acute peritonitis of appendicular origin. This case had been one of walled-in appendicular abscess, with drainage without removal of the appendix. At the time of our later operation all the walling-in adhesions were gone, but the vascular membrane was well marked. This is the only one of our cases with antecedent acute appendicitis. We have also seen one or two cases which strongly suggested a congenital origin

and verified a suspicion of the correctness of Keiller's (also Cotte's) omental idea. Also a few cases with alternating constipation and diarrhoea have led us to suspect a coincident colitis, as believed by Gerster. In quite the larger percentage of cases, however, we are of the opinion that the view suggested by Dr. Hall is correct. This opinion is the only one thus far substantiated by microscopic study including the entire gut. We do not assume, however, that one can be dogmatic concerning the revelations of only one case of real pathologic study. Surely, however, surgery here presents a definite problem worthy of the extended studies of the pathologist, whose aid must be invoked in the solving of the question of pathogenesis, since upon this solution may rest in such large measure the correct direction of surgical effort.

Symptomatology.—While the observation of our early cases was producing certain fixed opinions of a definite pathology, we were also, in the study of the clinical manifestations gradually, greatly impressed with certain striking similarities in the clinical histories of each. These impressions were remarked to several of our surgical colleagues, and, becoming likewise interested in the subject, they were soon able to confirm both the pathological picture and the clinical syndrome. Finally, from these repeated personal observations, and with the assurance offered by the corroborative evidence of these colleagues, we became convinced that this interesting pathological condition should be susceptible of absolute clinical diagnosis. Finally, in the early part of May, 1908, came the first case in which we attempted to make such a diagnosis before operation. This diagnosis was fully confirmed when the abdomen was opened. Between this time and that of the publication of my original paper in March, 1909, we operated upon nine cases in which this membrane was found, and in no case where such diagnosis had been made did we fail to find the corresponding pathological picture. This clinical report of several of these cases was given in detail in our original paper and will not be repeated here. These conclusions have been further confirmed by an experience in the observation of, at the present, in all, about thirty-five cases. We feel, there-

fore, that this positive pathological condition has an equally positive clinical picture. The following symptoms combined are usually sufficient to establish a definite clinical syndrome:

1. *Pain*.—In every case pain has been the dominant symptom which has caused the patient to be referred to us for surgical relief, usually in the belief that the patient was suffering from appendicitis or gall-stones or, in several instances, gastric ulcer. This pain practically always has at some period a definite abrupt onset. Sometimes the pain is quite severe, sometimes no more than distinct distress. When once started the case is usually distinctively progressive in its development, though oftentimes, in the early stages, with remissions of comparative comfort for variable periods. Later the pain or discomfort is practically constant, though marked by periods of acute exacerbations ("spells"), oftentimes requiring morphine for relief. The pain is quite generally diffused over the entire right side of the abdomen, though oftentimes particularly accentuated over the cæcum and at the hepatic flexure beneath the ribs. These several attacks of pain are not, however, as a rule, attended by any elevation of temperature or by any pulse disturbance. They are rarely, if ever, referred to the epigastrium.

2. *Tenderness*.—A *diffuse tenderness* is likewise characteristic, but *without any attendant rectus rigidity*. This tenderness oftentimes approaches an hysterical *hyperæsthesia*, and may be such as to render the pressure of clothing quite unbearable. While, like the pain, the tenderness is diffused pretty well over the entire right side of the abdomen, particular points are frequently observed low down in the groin, at McBurney's point, and just beneath the costal margin. These particular points of tenderness generally lead the practitioner to refer the case to a surgeon with a diagnosis of either ovarian trouble, chronic appendicitis, or gall-stones—or a combination of each. The *distinctly localized* symptoms of these varied conditions, however, are lacking.

3. *Constipation*.—Constipation is marked, particularly in well-developed cases, and large doses of any cathartic are required to secure evacuation of the bowels. The thorough

emptying of the gut, however, oftentimes affords distinct but transitory relief. Castor oil usually cures for a few days. In some instances the constipation has existed long before the pains began, sometimes there was none before. It is certainly exaggerated after their onset.

4. *Bloating by Gas*.—The formation of gas with much bloating is usually a marked symptom, particularly in the periods of exacerbation. This bloating is most marked in the lower abdomen, and is due to the great distention of the cæcum. It tends to grow worse and in itself causes much distress, and the patient complains much of the constriction of clothing. This gaseous distention of the cæcum is oftentimes sufficient to be apparent to the eye in inspection of the abdomen. On palpation the fulness is evident, and gurgling is readily demonstrated by manipulation with the fingers. Sometimes relief is experienced by pressure over the cæcum, as in leaning against a table or bed or lifting the lower right abdomen with the hands. Sometimes, under such manipulation, the gas can be felt to pass onward with corresponding relief. Abdominal massage properly used may give temporary relief.

5. *Mucous Diarrhœa*.—In long-standing cases constipation may alternate with mucous diarrhœa. In nearly all cases some mucus will be found on examination of the stools, but is usually not sufficient to attract the attention of the patient, and the fact is only elicited on direct inquiry.

6. *Gastric Disturbances*.—Disturbances of digestion are rarely absent, and are oftentimes so pronounced as to make them dominant and lead to a primary diagnosis of "chronic gastritis" or "gastric ulcer." They are not influenced by diet or even, as a rule, by fasting. They have no definite relation to the period of gastric digestion, and are only benefited by purgation, and then but for a while. The gastric analysis is likewise variable. In all, these stomach symptoms conform with what we to-day generally recognize as those of functional gastric disturbance, with the real disease elsewhere. In this connection it is well to quote from a recent address of Moynihan where he says, "In my own experience the commonest

site of a 'gastric ulcer' is in the right iliac fossa, and I have no doubt that in the majority of the cases which form the basis of the text of the very careful and elaborate treatises by the physicians of all lands upon 'gastric ulcer' no morbid process of this kind was present."

7. *Loss of Weight and Tone*.—As the case progresses the patient begins to exhibit the usual signs of intestinal toxæmia, with general impairment of nutrition and vitality. He begins to lose flesh quite perceptibly, and with the loss of weight is a corresponding loss of strength and tone. He becomes weak and lacking in ambition, the skin becomes mottled and discolored, the facial expression shows depression, and the general picture of intestinal auto-intoxication is complete.

8. *Neurasthenia*.—Finally, the patient becomes markedly neurasthenic and even melancholic. All symptoms are exaggerated, and it would take volumes to record their chronology of complaints. When our surgical efforts proved futile it was easy to fall back on the all-sufficient excuse, neurasthenia.

Differential Diagnosis.—We believe a diagnosis can almost always be correctly made by a careful study of the case under the analysis of the foregoing symptoms, particularly after one has once had the experience of even a few well-observed cases. Thus far we have found little difficulty in diagnosis through the analysis of the clinical symptoms and physical examination alone. In fact, we have been able to arrive at a positive diagnosis in all well-matured cases on clinical evidence alone, and in no case in which such diagnosis had been made did we fail to find the membrane. It is, however, true that the membrane, in several instances, has been discovered in the course of abdominal work for other conditions where it had not been suspected. In none of such cases, however, was the membrane producing any mechanical interference with the free action of the colon. It is therefore apparently only productive of diagnostic signs when it has become a factor in the establishment of mechanical interference with intestinal peristalsis.

For additional evidence the use of the X-ray, following the ingestion of bismuth, has proved of considerable value, and

has been well presented by Lane, Pilcher, and others. For the technic of this use of the bismuth meal we quote as follows from Pilcher:

"Technic of Bismuth Meal.—The bowels having been emptied during the day by a dose of castor oil, the patient is given, at ten o'clock in the evening, a mixture containing from two to four ounces of bismuth subcarbonate, the amount to be determined by the size and weight of the patient. To this are added six ounces of mucilage of acacia, and the quantity thus obtained made up to sixteen ounces by top milk, which serves to disguise the insipid taste of the bismuth and the acid taste of the acacia. The patient then reports to the radiographer the following morning at nine o'clock, after an approximate interval of twelve hours, at the end of which time it will usually be found that most of the bismuth emulsion has passed the terminal ileum and has already filled the first part of the big gut. Subsequent exposures must be determined according to the degree to which the bismuth is found to have progressed along the bowel at the first examination. In many cases a supplementary enema of bismuth is administered through a short rectal tube. Observation shows that the emulsion is carried around to the cæcum within four or five minutes by retrograde peristalsis. By combining the two methods a good demonstration of the entire intestine can be secured."

The evidences furnished by skiagraphic work with bismuth are in general those of local stagnation in the ileocaecal region, and particularly will demonstrate the dilated and oftentimes prolapsed cæcum. Repeated pictures at intervals also demonstrate the retardation of the fecal current in the ileum, in the cæcum, at the hepatic flexure, or anywhere that obstruction may occur.

With the rather broad distribution of symptoms resulting from membranous pericolitis there may be quite a number of other conditions simulated and require differentiation.

1. *Chronic Appendicitis.*—The most common error has arisen in diagnosing this condition as chronic appendicitis, a mistake often made, indeed. It should be remembered, however, that the appendix, as a small localized organ, should give, when inflamed, rather correspondingly definite local signs. The tenderness of chronic appendicitis can, even by the patient himself as a rule, be focalized with the finger-tips, though the exact spot must vary with the anatomical site of the appendix in the individual case. In membranous pericolitis, in marked contrast, the tenderness is diffuse, as the lesion, over practically the entire right side

of the abdomen. It cannot be covered with the finger or even the hand, but the patient, in endeavoring to signify the site of pain, passes his fingers from costal margin to Poupart's ligament. It is true that he will usually in time find spots of rather exaggerated tenderness, as at McBurney's point, due to the distention of cæcum, and beneath the costal margin where is found the hepatic flexure as well as the gall-bladder. But these are not distinctly focal points of focal disease. An attack of acute appendicitis with diffuse peritonitis leaving behind extensive adhesions might produce similar signs of diffuse pain and tenderness, but in membranous pericolicitis there is never any history of such antecedent acute appendicitis, no fever, no rigidity, no tumor, no prolonged acute bed illness. Furthermore, in the true chronic appendicitis the pain is in most instances referred to the epigastrium, and the local signs of appendicitis become well marked only when the inflammation is sufficiently acute to extend to the peritoneum. In membranous pericolicitis the pain is always distinctly confined to the right side of the abdomen, and is never epigastric. There may be many stomach disturbances, but rarely gastric pain. This significance of epigastric pain in chronic appendicitis is indeed noteworthy. Stanton, in the analysis of end results in a traced series of one hundred cases operated upon for presumably chronic appendicitis, remarks, "in our cured cases of chronic appendicitis the pain has been almost constantly referred to the epigastric or mid-abdominal rather than to the right inguinal region. On the other hand, nearly all the patients not benefited by operation complained of right inguinal pain as one of the chief symptoms."

2. *Gall-bladder*.—The diagnosis of gall-bladder disease has also been one of the sources of error. The marked angulation of the hepatic flexure and the pain occasioned as intestinal contents attempt to pass this point of narrowing suffice to explain the confusing symptoms. Of course, there is no jaundice and no true biliary colic. But even so these signs may be lacking in true gall-stone disease. But the one significant point is the absence of distinct localized exclusive pain or tenderness beneath the ninth costal margin, which should be distinctly focal in cholecystitis, but is diffuse in pericolicitis; also, there is seldom transmitted subscapular pain in this condition.

3. *Gastric Ulcer*.—The diagnosis of gastric ulcer has also been made, and, indeed, often strongly claims one's attention, in view

of the almost universal presence of digestive disturbances in these colonic disorders. In pericolitis, however, the gastric symptoms present no definite type, and have no special relationship to gastric function, either in time of occurrence or in character. They are only influenced by intestinal evacuation. The present-day conception of extrinsic gastric symptoms, and reference will readily protect the careful analyst, with the presence of the other distinctive intestinal signs.

4. *Ovaries*.—In women the cæcum distended and down low in the pelvis leads one to consider ovarian disease, and doubtless many ovaries have been taken out on such erroneous conclusions. Again, however, we must note the absence of focalizing limitation or association with menstrual function, and pelvic examination should clear remaining doubts.

5. *Chronic Colitis*.—The term colitis as used in the past has been so all-embracing as to cover every phase of large intestinal activity, and doubtless many cases of membranous pericolitis have found refuge beneath its sheltering wing. A true colitis, however, should show more evidences of increased mucous secretion. Diarrhœa, therefore, should be largely characteristic of colitis, with abundance of mucus in the stools most of the time. In membranous pericolitis, *per contra*, diarrhœa is absolutely rare, and mucus is only observed on close attention and then fixed to the fecal mass. In the opinion of some observers, colitis is a cause of the pericolic membrane. We rather incline to doubt this, but believe that, as the result of chronic retention and irritation in the gut restricted by the pericolic membrane, a colitis may occur as a secondary condition; and, furthermore, these cases have proved in our experience most resistant to treatment.

6. *Lane's Kink*.—The distinctly focal observation in the terminal ileum produced by the much-discussed Lane's kink may also be a source of confusion. When Lane's kink is found as a solitary lesion, however, the broad distribution of signs presented in membranous pericolitis is lacking. In fact, Lane's kink more nearly simulates a true chronic appendicitis, as it is likewise a distinctly localized process. It is usually referred a little lower down and more toward the middle line than the appendix, but the X-ray may be required to differentiate. The Lane's kink may, however, be associated with membranous pericolitis. When so associated it cannot at all be diagnosed in advance, but as a

possible factor should always be looked for when operation is undertaken for the broader condition.

7. *Kidney Stone*.—Kidney lesions, and particularly calculus, may occasionally be suggested, though such has never occurred in our cases. The urinary analysis and the X-ray findings are sufficient to dispel any doubt.

One fact at least has been clearly demonstrated. In cases of any surgical doubt of diagnosis a sufficient exposure should be made to disclose the entire ascending colon, which should then be systematically explored. The small incision and the too hasty operation on too confident diagnoses have been factors which have led us into many distressing failures. If we progress no further from these studies of membranous pericolicitis than to enable us to avoid previous errors in diagnosis and correspondingly fruitless surgical efforts we shall have gained much. With this more accurate study, however, as a basis, may we not look forward to ultimate surgical achievement in cure?

Treatment.—From what has been said as to the quite varied opinions expressed concerning the etiology of this condition, it might reasonably be inferred that the views of treatment would be equally divergent. And to one who has followed the rather extensive literature of the subject within the past year this variance becomes evident. And such is but to be expected in any new field of investigation. We are frank to confess that our own personal opinions are as yet undecided, and only with time and an honest and impersonal criticism of actual experiences can the true condition be obtained.

1. *Non-surgical Treatment*.—We have, as before stated, observed this apparent membrane in several instances with relatively slight symptoms; and in these cases the membrane was evidently producing no mechanical interference with the gut activity. These observations lead us to believe that possibly some cases, particularly those in which an early diagnosis can be made, may be cured by proper treatment without resort to surgery. And particularly would this inference appear correct if we accept the view of a colitis or an over-

absorption of irritant toxic or infective material in the colon as the beginning point of the disease. Upon this presumption the logical non-surgical treatment would involve: (1) the proper drainage of the large intestine and the removal thereby of causative factors; (2) the establishment of a correct dietary to eliminate factors of fermentation, putrefaction, and irritation; (3) methods for development of normal evacuant capacity of a gut whose muscular tone is impaired or interfered with—as by massage and exercise; (4) direct medication of the colon, mainly through colonic lavage, aided by varied possible specific medicinal agents; (5) external supports to correct malpositions and obviate the stasis of gravity.

Tyrode of Boston reports a series of cases of clinical history analogous to those found in the early stages of this condition, which under systematic treatment along such lines were greatly relieved or cured. For details of such treatment we refer one interested to the complete description of Tyrode. We are particularly inclined to emphasize the importance of efforts to restore normal muscular tonicity. Cathartics, while occasionally required, are in the end only a makeshift. Correct massage of the colon to aid evacuation of the gut and at the same time to restore muscle tone is of much value. Likewise we consider valuable exercises which bring into use the abdominal muscles and render them auxiliaries to those of the intestine. In fact, we are of the opinion that the sedentary habits of modern civilization, with the negative assistance of relaxed abdominal walls on a comfortable seat in the modern closet, are potent factors in the general tendency to constipation. The relatively weak involuntary muscles of the intestinal wall were never intended to do the entire work in producing evacuation of the intestinal contents. The compressive action of the abdominal muscles must be brought to their aid, and therein lies an important element in any non-surgical treatment. Where the factor of ptosis is added, proper abdominal support, as emphasized by Franklin Martin, is obviously valuable, but should not be carried to such an extent as to interfere with the proper activity of the abdominal muscles. Hot-water flushing of the colon not only removes toxic

material and products of putrefaction, but is furthermore stimulant to correct glandular secretion and intestinal motility. We have not considered added medication of these colon flushings as of much added value, as there is so seldom much mucous discharge in typical cases.

Surgical Treatment.—In our experience most cases have been treated for rather prolonged periods, oftentimes even for years, before surgical advice is requested. Such evidences would not lead to much enthusiasm for conservative treatment in the average case. In fact, most of our patients have progressively grown worse, even in the face of prolonged medical efforts. And, indeed, when one views the extensive pathological changes on the outer gut surface in typical cases, one could not well hope for any real curative results from any internal medication. When fully developed it is apparent to anyone who has seen a case that the cure must be mechanical and thus require some form of surgical intervention.

But here, likewise, we are confronted with considerable disagreement of surgical opinion in keeping with the divergence of pathological conception. In order to fully comprehend the situation it is well to view briefly these varied surgical procedures. Several of these procedures have been suggested for presumably quite different conditions, but, we believe, have covered conditions of membranous pericolicitis and add some information to the subject.

We have expressed the opinion that Mr. Lane has covered the same subject in large measure from a different viewpoint. Considering intestinal stasis in the colon as the starting-point of all trouble, Mr. Lane has directed his surgical efforts to the end of sidetracking the main portion of the colon and permitting a shorter and quicker outlet for intestinal waste. It is evident that in his opinion the individual would be better off without the colon altogether. His first efforts were directed, however, to a simple short-circuiting by ileocolostomy. From this he derived much benefit, but not complete satisfaction. The well-known fact of reverse peristalsis in the colon would still carry contents back into the segments which he desired to exclude. He then began the plan of

supplementing the ileo-sigmoidostomy by excision of greater or less segments of the remaining colon, and a few years ago advocated the radical excision of the entire colon from the ileocæcal juncture to the sigmoid. This radical suggestion met with little acceptance elsewhere on account of its apparent magnitude. And now Mr. Lane has himself abandoned the plan on account of several instances of distressing after-effects and an excessive mortality, mainly from true adhesions. In his latest communication he has returned to the simple ileo-sigmoidostomy, now supplementing it, however, by an effort to establish a new and artificial kink above his point of anastomosis to prevent reverse peristalsis carrying the feces back to the right colon. This method has not long been used, and his ultimate experience with it is yet conjectural. If it is successful in preventing reverse peristalsis, the question naturally arises, may we not pass from constipation to diarrhœa, and, if so, where are we better off? With effective cut-off of reverse peristalsis, the further question of nutrition arises, with so large a part of our food products excluded from the absorption of the first portion of the colon, and, instead, rejected promptly from the anus. In all, the method of Mr. Lane has never appealed to us sufficiently to warrant our giving it a trial, though unquestionably some good and satisfactory results have been reported by Mr. Lane, and also by others who have followed his lead.

For a good many years cases of various types of chronic colitis have been treated by *cæcostomy*, as recommended first by Gibson of New York, or by *appendicostomy*, a modification of Gibson's idea introduced by Weir, also of New York. Through a fistulous opening thus provided the gut could be directly treated by irrigation, supplemented with such local agencies as might be indicated. Many most satisfactory cures have been reported from such treatment. If the theory of Gerster as to the origin of the pericolic membrane from a primary chronic colitis is correct, then this might logically have a place here. In critical reviews of the results of *cæcostomy* and *appendicostomy*, however, one is struck by the rather frequent occurrence of such remarks as this: "The

patient was entirely relieved until the fistula was permitted to close, when the symptoms recurred"; or "the patient will not permit the fistula to close." Is it not highly probable that these cases of supposed chronic colitis were indeed ones of pericolicitis instead? The vent which relieves tension could thus afford relief while maintained, but with the pericolic membrane still present, a recurrence of symptoms would be inevitable when the vent was closed. It is evident, hence, that a simple cæcostomy would not cure membranous pericolicitis. But if this operation were preceded by methods which would secure removal of the constricting or restricting membrane (the sequence of colitis, if this theory is correct) it might offer a logical method for curing the original colitis. While this procedure has never been adopted by us, largely alone because of the objectionable fistula, it may yet become a method worth serious consideration.

Viewing the dilated and mobile cæcum as the fundamental cause of the symptoms presenting, Wilms, years ago, suggested a *cæcoperxy* as the correct treatment. This operation was designed to fulfil two functions: (1) to elevate the prolapsed cæcum out of the pelvis, and (2) to fix it so as to prevent kinking in peristalsis and likewise to relieve tug on bowel and appendix. This procedure has been utilized in quite a considerable number of cases by Wilms and others in Germany, with approximately seventy per cent. of cures. Wilms's method was to fix the cæcum in a pocket of peritoneum made just about the brim of the pelvis, into which the lower end of the cæcum was slipped. To this method, in women at least, objection has been made by a number of obstetricians on the ground that thus placed it would become the source of trouble in pregnancy from pressure of the uterus thereon, as well as by the limitation of upward lift of the cæcum, which should take place as the uterus ascends. Others have suggested instead its fixation to the anterior parietal wall. Gregory Cornell, who has followed our suggestions of stripping off the investing pericolic membrane, has left this membrane attached to the cæcum at its lower end, and twisting the membrane into

a cord has brought it through the parietal wall as a ligament of suspension.

Other German surgeons, believing the dilatation rather than the mobility of the cæcum to be the productive factor, have attempted to correct the condition by *plication* of the cæcum instead, on the same principle which has prevailed in plication of other dilated organs, such as gastro-plication, for the stomach. This has really seemed more logical to us than the fixation method of Wilms, though, indeed, both might be combined.

If our view is correct, however, that the dilated cæcum was a secondary matter, the result of long-continued distention resulting from the restriction of the pericolic membrane above, we would naturally expect the results of either of these methods alone to be transitory, and that with the cause remaining a recurrence of dilation would be inevitable. We would like, therefore, to know the remote results of such measures alone before accepting them as logical surgical procedures.

We are, however, inclined to consider some such procedure a valuable step in the mechanical relief of the obstructive effect of the pericolic membrane. When this is accomplished, the secondary dilation of the cæcum should be attacked, for we believe it to be a distinct factor in the ultimate cure. We look upon the cæcum in many respects as the initial propeller in the colonic circuit. With obstruction in front, the cæcum becomes so stretched as to lose its tone and finally its function. Cannon has demonstrated that the colonic muscles in a normal condition of tonus respond to the presence of material within its lumen by the reaction of peristalsis. When, however, the tonus of the muscle is lost, as by overstretching, the peristaltic reflex disappears. The obstruction which produced the dilatation should, hence, be first overcome. Otherwise, even though cæcopexy or cæcal plication for a while might be efficient in restoring normal tones, we would naturally expect, with the original factor still present, a recurrent dilatation with all its sequelæ.

On the other hand, with the removal of the obstruction

alone, we yet leave a dilated cæcum with deficient primary propulsion of the fecal current. Hence this method alone will likewise sometimes fail. And such has been our experience. In our original operations we limited our surgical efforts to the removal of the constricting effect of the pericolic membrane which we attempted to remove entirely. In about 75 per cent. of our efforts the result was entirely satisfactory, with complete relief. In a smaller percentage we secured benefit in part, and in a few cases no benefit whatsoever. The latter cases were usually of long standing, and the dilatation of the cæcum was well marked, with considerable bloating and oftentimes with occasional diarrhœa. Believing that the condition of the cæcum was perhaps the cause of our failure here, and recalling the experiences of Wilms and his followers, who secured about the same percentage of cures from cæcoplexy or cæcal plication alone, it occurred to us that our original efforts might be supplemented by this procedure with advantage. Of these two German methods, plication has seemed to us to be more logical. When properly done it secures a shorter length of muscle action, thereby restoring tonus and with it the initial peristalsis so necessary. This plication can be accomplished either by longitudinal reefing mattress sutures, usually one paralleling each longitudinal band, or by two or three series of transverse sutures turning in each a fold of about one-quarter inch depth. These sutures are planned to pick up the muscular coat as well as the serosa, and as material we have used linen. This combined procedure we have utilized now for nearly a year in about ten cases, and with apparently, thus far, perfect success.

One further word here may be spoken concerning the method of dealing with the obstructive membrane. Most of the surgeons who have given attention to this condition have contented themselves with simply dividing the bands at the points of particular fixation, stretching them apart and in some instances doing plastic suture to cover the resultant raw surfaces in some manner to prevent adhesions without at the same time restoring the constriction. And in general they have reported good results from this method. In our original

communication we suggested the more complete removal of the entire membrane, which is easily accomplished. Of this method the theoretical objection was offered that it would leave large raw surfaces which might invite adhesions. On likewise theoretical grounds we assumed that the remaining covering of the supposed raw surface represented an epithelial lining of lymph space which could take the place of the normal peritoneum. Since our original communication we have operated upon two cases in our clinic where other surgical conditions of the abdomen were known to coexist and were left for future operation in order to afford opportunity for observation of the effect of the colonic stripping. These two cases, when re-operated at the end of six months and one year respectively, showed no adhesions whatsoever, thus apparently justifying our theoretical assumption. The primary effort, however, is to relieve restriction, and the extent of dissection of the membrane should be governed by this necessity alone.

In some cases the angulation of the hepatic flexure is particularly marked, and the obstruction is found chiefly here. Likewise in these cases the pericolic membrane is particularly dense and extensive. In such cases particularly the suggestion of Hoffmeister is worth consideration. He has resorted to a lateral anastomosis between the ascending colon and the descending loop of the transverse colon, thus affording a new and satisfactory channel for the easy and complete emptying of the stagnant ascending colon and cæcum. Where such an object appears desirable it has occurred to us that a method similar to that of Finney's pyloroplasty applied at the hepatic flexure would be particularly adaptable. Thus far, however, we have not had occasion to try it, but expect to when a suitable case presents.

In one instance at least, reported in our original communication, the membrane was a solid sheet of fibrous tissue perfectly opaque and entirely obscuring the entire ascending colon and hepatic flexure, which could not be recognized at all until the membrane was divided and stripped away. Then we discovered a small contracted atrophied colon which we believed incapable of restored function. In this case we excised the

entire ascending colon, including the hepatic flexure, and made an anastomosis between the ileum and transverse colon, thus entirely curing our patient. Occasionally it may be necessary to repeat such a procedure.

Finally, we are of the opinion that no one method will be found applicable to all cases, and that it is well to have in mind all the varied methods enumerated. A judicious surgical selection will give better results than any one method followed as routine. In the majority of cases the removal of the obstruction of the pericolic membrane, supplemented by a cæcal plication, is our present method of choice. In more advanced cases some method of direct drainage, as by a plastic anastomosis at the hepatic flexure, will be preferable, and occasionally a more radical operation, as excision of the ascending colon, may become necessary.

In conclusion we desire to emphasize, as we did in our first article, that any surgical procedure must be followed by a vigorous after-treatment along general lines before indicated. Correction of diet, regulation of habits, muscular exercise, and abdominal massage, with colonic lavage occasionally, should be considered essential factors in restoring proper tone and function to an intestine long disabled.

Since completing the above article, a new method of short-circuiting the colon has been suggested by Dr. Frank C. Yeomans, of New York City, in the *American Journal of Surgery*, January, 1913. Yeomans makes an anastomosis between the cæcum and sigmoid (cæcosigmoidostomy). With the usual mobility of the sigmoid and the elongated cæcum, an anastomosis of this type is easily effected, as judged by his experiences in three cases. This method appeals to us as superior to that of ileosigmoidostomy as it provides free drainage to both ends of the short-circuited colon. Even should reverse peristalsis carry fecal contents back around into the cæcum, it would again drain out through the anastomosis into the sigmoid and not invite recurrence of stasis in the cæcum and ascending colon. Theoretically, we are much impressed with this technic if any short-circuiting is demanded.

CARCINOMA OF THE PAPILLA OF VATER.

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PRIMARY carcinoma of the duodenum; while not being of sufficient rarity to be in any sense classed as a pathological curiosity, is nevertheless extremely infrequent in occurrence as compared with many other forms of cancer. Thus, Geiser reports that in a series of 5865 autopsies on *cancer patients* the duodenum was affected but 23 times, or in about 0.4 per cent. McGlinn found in going over the records of the Philadelphia General Hospital that in over 9000 autopsies there was but one instance of carcinoma of the duodenum, and Sears, in 1904, reported a carcinoma of the papilla of Vater as being the first example of that condition ever found in the autopsy room at the Boston City Hospital.

The large majority—about 70 per cent.—of all carcinomata occurring in the duodenum are located at the papilla of Vater, and possess, therefore, greater clinical interest than their relatively infrequent occurrence would indicate, owing to the great physiologic importance of this portion of the intestinal tract. So long as this region was considered a *noli me tangere* from the operative stand-point, carcinomata in this locality possessed more of a purely pathological than surgical interest, but in view of the fact that within the past few years over 20 cases have been reported, in which attempts at the radical extirpation of such malignant tumors have been made, apparently followed in a few instances by permanent cure, this can no longer be considered true, and any case which has a bearing on the subject would seem worthy of report. The following case came under the writer's observation through the kindness of Dr. Theo. A. Erck, at whose request the autopsy was performed. I am indebted to him for the privilege of reporting it, and to Dr. W. H. Fritts for the clinical notes.

Mrs. G., age sixty-five years. Aside from rheumatic attacks at times, patient enjoyed good health until August, 1909, when she complained of a "bilious spell," with lassitude, and severe pains in the back, gall-bladder region, and left arm; this was accompanied by distinct jaundice. Her condition improved somewhat, but in January, 1910, she had a recurrence of the same symptoms, and again in October, 1910, from which time the jaundice steadily increased until her death in May, 1911. She complained a great deal of "indigestion," and during the latter part of her life was able to eat very little, but was comparatively free from pain. In April, 1911, she went to the Hahnemann Hospital; at this time a distinct mass was palpable below the right costal margin. The surgeons at the hospital advised operation, but this she refused and returned home. From this time on she steadily went down hill; during the last week she was in a state of extreme exhaustion, and had a number of convulsions, associated with nausea and great thirst.

Autopsy.—Body considerably emaciated; skin everywhere of a deep bronzed color. On opening the abdomen a large amount of bile-stained, ascitic fluid escaped. The liver, gall-bladder, stomach, duodenum, and pancreas were removed *en bloc*; no changes of importance were found in the other organs. The liver was rather hard and deep yellowish-brown in color. The gall-bladder was the size of a large orange, thin walled, tense. On being opened, it was found to contain perfectly clear, mucoid fluid, and a single gall-stone, about the size, shape, and color of a large olive. No trace of the cystic duct could be found, it evidently having undergone complete obliteration.

The stomach was opened by an incision along the greater curvature, which was continued through the pylorus and throughout the duodenum. Some slight difficulty was experienced in locating and passing a probe through the papilla of Vater; this was finally accomplished, however, the probe meeting with a slight resistance at the entrance to the duct. The latter was slit up throughout its entire length, using the probe as a guide. The distal portion of the common duct, just at its entrance into the duodenum, was found to be extremely constricted, the lumen being filled with soft, shaggy tissue, through which the probe had been forced. Somewhat less than 1 centimetre above the orifice, however, the duct became enormously dilated, measuring, when opened and spread out, 7 to 8 centimetres across. The lining of this portion appeared smooth and shiny; there were no stones. A marked degree of dilatation was found throughout the hepatic duct as well, and extending into its larger branches, it being possible through several of these to pass the little finger well into the substance of the liver. No trace of the entrance of the cystic duct could be discovered.

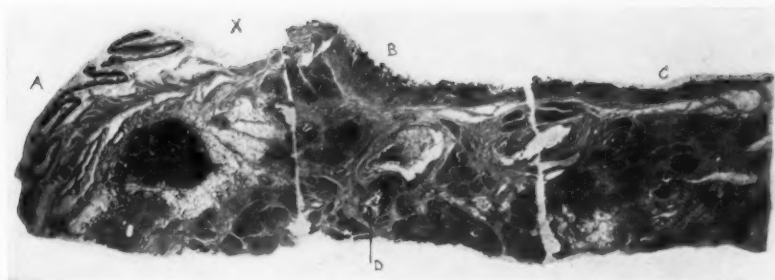
The pancreas felt very hard and nodular, and the gross diagnosis of carcinoma of that organ, with pressure on the common duct, was made. No dilatation of the duct of Wirsung could be made out macroscopically, nor were any cysts to be seen.

Microscopic Examination.—Sections made from various parts of the pancreas reveal the presence of a moderately high-grade chronic pancreatitis, with some subacute inflammation as well, the pancreatic acini being separated by broad bands of connective tissue, which shows in certain areas a fairly intense round-cell infiltration. The excretory duct and its branches show some dilatation, though this does not anywhere become very pronounced. Very many of the acini likewise show a slight cystic condition, not presenting the usual appearance of practically solid groups of cells, but containing a distinct lumen, around which the cells are arranged in a band of varying thickness (Fig. 3). This condition of the acini forms the most striking histologic feature of the pancreas—it exists throughout the entire organ, but is more marked in sections taken from near the head, the cystic acini decreasing markedly in numbers as the tail is approached. Nothing suggestive of malignancy is found in any of these slides, but a large section taken through the wall of the duodenum, passing directly through the papilla of Vater into the common duct and including a portion of the underlying pancreas, shows the presence of a small area of carcinoma situated exactly at the papilla, apparently arising from the duodenal mucosa. This is well shown in Fig. 1, a very low-power photograph. At *A* the duodenal mucosa is entirely normal, but as the region of the papilla is reached (a small portion of the mucosa at *X* became accidentally torn off during the preparation of the tissue) the mucosa becomes markedly thickened, and under higher power presents the typical appearance of a cylindrical-cell, glandular carcinoma. The histologic picture here is that of a rather dense connective-tissue stroma, everywhere riddled with atypical, irregular, gland-like formations, exceedingly variable in size and shape, lined by fairly tall, mucoid cells, arranged for the most part in a single layer, but presenting in places a distinct multi-layered formation (Fig. 2).

While by far the greater portion of the carcinomatous process is limited to the thickened intestinal wall, several scattered nests are found fairly deep in the portion of the pancreas immediately beneath this region. These present the same general characteristics as those already described, and are for the most part to be readily distinguished from the pancreatic tissue, though in places some difficulty is experienced in distinguishing some of the smaller cancer alveoli from slightly dilated and irregular pancreatic ducts, owing to the great similarity of the lining cells. Aside from this pancreatic involvement, no extension of the carcinomatous process beyond its point of origin is to be seen. The liver shows a moderately high grade of cirrhosis.

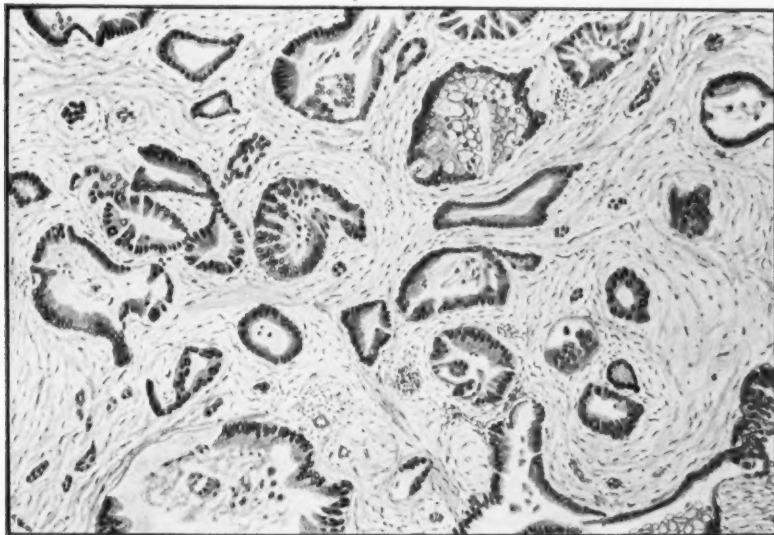
The exact point of origin of a primary carcinoma occurring in the region of the papilla of Vater is usually extremely

FIG. 1.



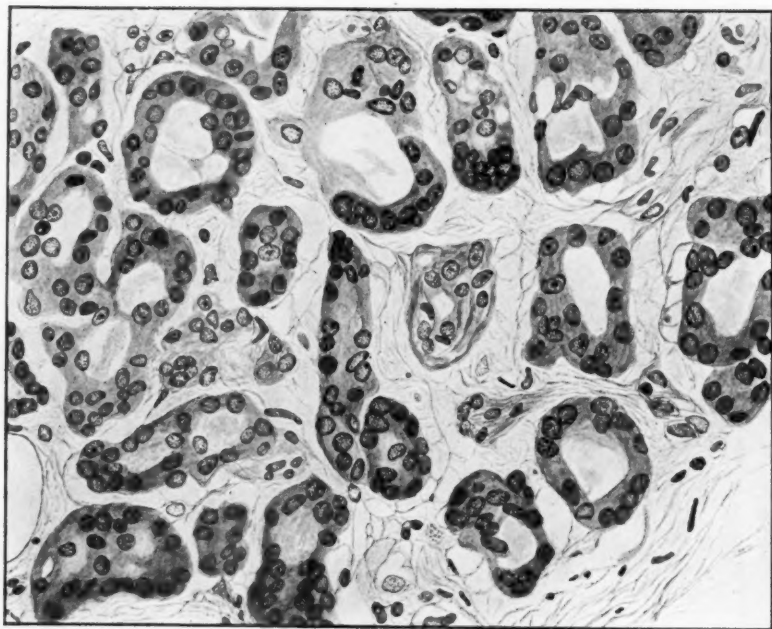
Section through the papilla of Vater, A, normal duodenal mucosa; B, carcinoma at site of papilla of Vater; C, common duct; D, carcinomatous area in the pancreas.

FIG. 2.



Carcinoma in duodenal wall.

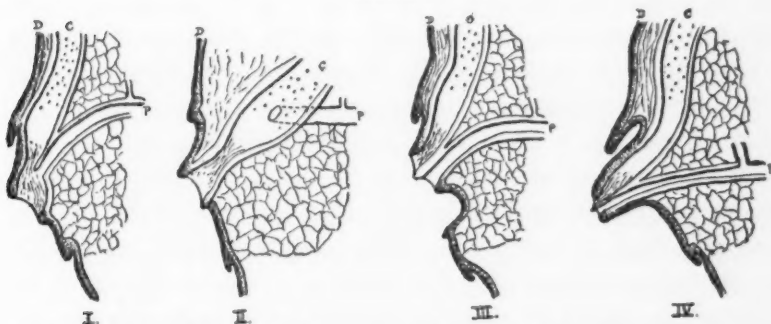
FIG. 3.



Section from pancreas, showing cystic acini.

difficult and in many instances impossible of determination. The structures involved are extremely small in size, complex in arrangement, and their anatomic relations are by no means constant. A true *ampulla*, in the sense of a small pouch or sacculation, lying within the papilla, and receiving on the one hand the pancreatic and common ducts, and emptying on the other hand into the duodenum (Fig. 4, Type I), is present, as has been shown by Letulle, in only about one-third to one-fourth of all individuals. More often one of three chief

FIG. 4.



Anatomic relations of the bile and pancreatic ducts at their duodenal end (after Letulle).
D, duodenal mucosa; C, common duct; P, pancreatic duct (Wirsung).

variations is found: either the pancreatic duct merely empties into the choledochus at some distance from the duodenal wall, without the formation of a true ampulla (Type II); the two ducts open side by side on the surface of the intestine, without the formation even of a papilla (Type III); or the two ducts together form a prominent papilla in the duodenal lumen, but remain separate (Type IV). Finally, the ducts occasionally empty some distance apart, bearing therefore practically no relation to each other. By no means all primary epithelial tumors of the Vaterian region arise from the duodenum proper, but theoretically at least six points of possible origin must be considered: (1) the epithelial cells lining the true ampulla, when this is present; (2) the cells lining the common duct at its lower end; (3) the cells lining the pancreatic duct at its lower end; (4) the duodenal mucosa immediately cover-

ing the papilla; (5) the glands of Brunner, situated beneath the duodenal mucosa; (6) aberrant pancreatic acini in the wall of the common duct. As will be seen by reference to Appendices A and B, tumors have actually been described as arising from each of these structures. Owing to the intimate relationships between these, however, and to the great similarity in form of the lining cells of many of them, even an exceedingly small growth may have so extended beyond its immediate point of origin that this can at best be conjectural.

In the specimen under consideration, the gradual passage of the duodenal mucosa from a normal condition into the carcinomatous area, the fact that by far the greater portion of the latter is situated in the mucosa, and the characteristic form of the carcinoma acini and of their lining cells, all indicate the origin to have been in all probability intestinal. The only other points of origin that in this case could seriously come into consideration would be the lining cells of the ampulla, and the pancreas. The latter can with reasonable certainty be excluded, for the scattered areas of carcinoma in that organ, many of them apparently lying in lymph spaces, present all the characteristics of a secondary invasion, as contrasted with the much more compact and continuous involvement of the intestinal wall. The possibility of an origin from the cells of the ampulla must, however, be admitted, though owing to the characteristics stated above, and the much greater frequency of duodenal as compared with true ampullar carcinoma, the present case must be considered as falling within the former group.

Considerable labor has been spent by various investigators in attempting to discover some histologic characteristics by which it would be possible to differentiate with certainty ampullary, ductal, and duodenal carcinomata, but these efforts have as yet been without definite result. From the practical stand-point, however, such a differentiation is at best more or less a matter of hair-splitting, for the symptomatology and surgical indications of all these tumors of the Vaterian region are similar, and bear little relation to the precise group of

cells in which they have originated. It appears justifiable, therefore, to consider this group of tumors more or less as a unit, although from the strictly histogenetic stand-point some—probably the majority—should be classed as duodenal, some as biliary, and a few as pancreatic in origin.

Etiology.—In considering the etiology of malignant growths of the papilla of Vater, the question of the gall-stone factor assumes the foreground of interest. It has been repeatedly shown that gall-stones are or have at some time been present in a large majority of cases of primary carcinoma of the gall-bladder, and, possibly to a slightly less extent, of the gall-ducts. This does not, however, appear to be the case with regard to the group of tumors which we may class as "Vaterian carcinomata," in these gall-stones appearing—from the reported cases at least—to play a comparatively minor rôle. Thus, Schüller, in 1901, found a history of gall-stones in but 15 per cent. of 41 cases of carcinoma of the papilla of Vater, and the writer, in an analysis of 110 cases from the literature, was able to find mention of stones in but 23, or about 20 per cent. Nevertheless, it must be considered highly probable that the passage of stones through the common duct must in a certain proportion of cases be an etiologic factor of great importance, especially since the papilla forms the most frequent point of incarceration, with attendant chronic irritation of the mucous surfaces. This would seem to be particularly true of the case here reported. The occurrence of a stone in the gall-bladder, the complete fibrous obliteration of the cystic duct, the very early occurrence of pain with the jaundice, the rather long intermissions between attacks at first, and especially the comparatively long interval—one and three-fourths years—elapsing between the onset of symptoms and death, all point to the probability of a primary condition of cholelithiasis with passage of stones, with secondary development of malignancy at the papilla.

Symptomatology.—The most complete analysis of the subject of malignant disease of the duodenum—including all tumors of the papilla of Vater, no matter what their histologic

origin—as yet made is that of Geiser, who in 1906 collected 51 cases of what he calls “periampullar” carcinoma. After a fairly extensive search through the literature, I have been able to collect 58 additional cases, giving, with the one reported in this paper, a total of 110 available for analysis. In Appendix A will be found a brief synopsis of all cases (20 in number, including five already reported by Geiser) which have been subjected to radical operation; in Appendix B is a similar synopsis of the cases in which either no operation, or merely a palliative one, has been performed. (For the sake of brevity, all cases without radical operation, already reported by Geiser, are omitted from Appendix B). This list makes no pretense at being absolutely exhaustive, as a number of cases have been reported in inaugural dissertations and other sources to which I have not had access.

In analyzing these 110 cases, we find that no single symptom is common to all, not even jaundice, which, however, is naturally by far the most frequent. In four cases it is distinctly stated that jaundice was not present; in two there was very slight discoloration of the sclera or skin, hardly sufficient to be classed as icterus, and in two no mention of the subject is made; in all other instances, however, jaundice, often of a most intense type, is specifically mentioned as a prominent feature of the clinical picture. In two of the cases (Durand-Fardell,¹¹ Devic and Savy) where icterus was not present, this fact is explained by more or less extensive ulceration of the central portion of the growth; in a third case (Lannois and Courmont) there was no constriction, but rather a dilatation, of the common duct at its point of passage through the tumor, due apparently to eccentric growth of the latter.

In the vast majority of cases jaundice was gradual in onset and progressive, though in quite a number the onset was sudden, and in a considerable proportion a distinct intermittency was noted. In most of the cases in which the jaundice was intermittent, it was so only in amount, never entirely disappearing after having once become manifest, though in a few instances there was complete clearing up between attacks. This intermittency was by no means associated only with those

cases in which stones were present; indeed, one author (Rendu) thinks intermittence in jaundice is due to variations in the turgescence and vascularization of a neoplasm, and considers it characteristic for tumor of the papilla as opposed to pancreatic carcinoma, in which the jaundice is more apt to be steadily progressive, a conclusion that can hardly be considered altogether correct, however, in view of the much larger number of cases of tumor of the papilla showing progressive than intermittent jaundice. Associated with jaundice in a large number of the patients were pruritus, rapid loss of weight, anorexia, and in practically all more or less marked discoloration of the stools, amounting in many instances to complete acholia.

Next to jaundice and its associated conditions, the most frequent symptom noted was pain. This feature is not included in Geiser's tabulation, but in the fifty-nine cases collected by the writer it was present twenty-seven times, or in nearly one-half. It is described as affecting chiefly the gall-bladder and liver region in six cases, the epigastrium in nine, the abdomen in eight, the back in two, not localized in two. In cases where the pain was distinctly colicky in nature, stones were usually, but not always, present. The occurrence of colics with tumor obstruction, in the absence of stone, is explained by Stein, who reports such a case, on the theory that as the result of bile stasis, with consequent distention of the gall-bladder and ducts, sufficient irritation of the nerve endings in the mucosa is produced to set up pathologic contractions of those organs, in an attempt to empty their contents.

Of less frequently occurring symptoms, vomiting is mentioned 12 times in the entire series of 110 cases, fever likewise 12 times, intestinal hemorrhage twice, ascites 3 times. In many instances, however, the reports of cases are so meagre and incomplete that undoubtedly many symptoms were present of which no mention has been made.

Duration.—A most important feature of malignant disease of the papilla of Vater, from the clinical stand-point, is the rapidity with which it usually proceeds to a fatal termination. Of 47 cases, in which the time elapsing between the

onset of noticeable symptoms and death is given with sufficient accuracy to be available, the average duration was but $7\frac{1}{3}$ months; the longest time reported was 3 years, in Mayo Robson's case, and there were but 3 others over $1\frac{1}{2}$ years. In one of these (Herrick, $2\frac{1}{4}$ years), the histologic diagnosis of the tumor was not carcinoma but "adenofibroma"; in the second (Morian, $1\frac{3}{4}$ years), obstruction was relieved comparatively early by a cholecystenterostomy; and in the third (the author's, $1\frac{3}{4}$ years), it seems probable that the earlier symptoms may have been due to gall-stones, rather than to the tumor. The extreme rapidity with which tumor of the papilla can produce death is shown further by the fact that of these 47 cases, in 23—practically 50 per cent.—the duration was 6 months or less, and in 10 it was under 3 months.

A second feature of great clinical importance is that in the majority of cases death ensues before metastasis or extension of the malignant process has occurred; in other words, while the condition is still, potentially at least, *surgical*. The views of different authors upon this subject are extraordinarily at variance, probably dependent upon each man's individual experience with a very small number of cases. Thus, Oehler says that tumors of the papilla possess marked tendency to metastasize, especially the adenocarcinoma types; Schüller, on the other hand, thinks that this rarely occurs, owing to rapid death of the patient; Geiser believes that the tendency to form metastases is very great, while Letulle and Kausch consider it slight. Examining the 110 reported cases from this stand-point, we find the occurrence of metastases noted 25 times, or in about 22 per cent.; in a few additional instances a limited amount of direct extension to the connective tissue lying between the duodenum and the pancreas, or to the pancreas itself, was present. In over three-fourths of the cases, however, the growth was limited to the papilla and its immediate surroundings, death occurring apparently as a result chiefly of interference with the flow of bile, and not as a result of malignancy *per se*.

A feature common to nearly all these tumors is their small size. Oesterreich mentions a growth at the papilla the size

of a small apple, Stein one of 5 cm. diameter, Lannois and Courmont one the size of a 5-franc piece, Martha one as large as the fist, but aside from these, and a very few others, practically all the tumors recorded are small, being compared by their reporters to a pea, bean, cherry, small nut, etc. In other words, it is evident that in the large majority of cases, a malignant growth at the papilla of Vater leads to the death of the individual before it has had time to reach any considerable size, or to become disseminated throughout the body. If subjected, therefore, to prompt and radical surgical attack, the condition should in a fair percentage of cases be curable, notwithstanding the great technical difficulties to be overcome.

Diagnosis.—The positive diagnosis of carcinoma at the papilla is a matter of great difficulty, and has comparatively seldom been made before operation or autopsy. There is, as has been shown, no pathognomonic or even any constantly recurring symptom associated with it. The conditions with which it is most likely to be confused are obstruction of the common duct by stone, benign stenosis from scar formation, chronic interstitial pancreatitis, and cancer of the head of the pancreas.

Where a definite swelling can be palpated in the gall-bladder region, associated with jaundice, rapid wasting, acholic stools, etc., presumptive evidence is furnished against stone and in favor of malignant disease, either at the papilla, or in the common or hepatic duct, as was originally pointed out by Courvoisier. It is impossible to say, however, in how many of the cases of tumor of the papilla this diagnostic aid was to be elicited; in comparatively few of the reports is any mention made of the presence of a palpable mass in this region during life. In almost every instance, however, very decided dilatation of the gall-bladder and common duct was found upon opening the abdomen at operation or autopsy, most of the few exceptions being cases in which there was perforation of the gall-bladder, with resulting collapse. In the majority of cases the degree of dilatation attained by the common duct is most striking, as in the author's specimen, where the duct measured, opened out, 8 centimetres across; a few cases of

even somewhat greater enlargement are on record. One would hardly believe that such extreme degrees of dilatation of this canal could take place in the short space of time elapsing, in many instances, between the onset of symptoms and death, but yet, while unquestionably the onset of symptoms may by no means be coincident with the beginning of the tumor formation, it does not seem probable that the common duct would undergo much dilatation until the tumor had reached a size sufficient to cause constriction of the lumen and produce marked damming back of the bile, at which time jaundice would begin to make its appearance. It seems probable, therefore, that the common duct is capable of undergoing rather rapid dilatation to many times its normal size.

An interesting and somewhat anomalous condition, which has been observed by a number of writers, is that of a much dilated gall-bladder and common duct, both filled with perfectly clear fluid, with *patulous cystic and hepatic ducts*, and obstruction at the papilla of Vater. A case of this kind has been carefully studied by Kausch.²⁶ At operation upon a patient with steadily increasing jaundice, the gall-bladder and common duct were found enormously distended with clear fluid; a cholecystostomy was performed, and for two hours clear fluid flowed from the tube. Then the discharge began to be slightly colored, and by the end of six hours it had assumed the appearance of somewhat pale bile, large quantities of which continued to flow as long as the sinus was left open. At autopsy, some weeks later, a small tumor was found at the papilla of Vater. Kausch thinks that the hydrops in these cases is due to excessive secretion by the mucosa of the gall-bladder and ducts, whereby, the duodenal opening being occluded, the pressure in the biliary system is so raised that the bile secreted by the liver cells is poured, not into the excretory ducts but back into the blood and lymph vessels of the liver. It is evident that the liver cells have not ceased to functionate, for had such been the case the jaundice would have disappeared, and the flow from the gall-bladder would not have become bile colored within a couple of hours after the pressure was relieved. Similar cases have been reported

by Lenormant, who agrees entirely with Kausch as to the mechanism of their production, by Arnsperger, Carnot and Harvier, Dominici, Halsted, Hanot,²⁰ Martha, Oppenheimer, Riedel, and Berg; in the last named the obstruction was due not to a tumor but to a stone, associated with infection of the biliary passages. The occasional occurrence of such cases is of importance from the operative stand-point, as they show that the mere fact of finding a gall-bladder filled with clear fluid is no proof of the occlusion of the cystic duct.

Pancreatic Changes.—The most frequent changes observed in the pancreas as a result of occlusion at the papilla of Vater—aside from the occasional direct extension of the tumor into the pancreatic tissue—are dilatation of the ducts, atrophy of the acini, and overgrowth of connective tissue. Dilatation of the ducts is, as a rule, moderate in amount, often only to be detected microscopically, and practically never reaching a degree comparable to that of the common bile-duct. Weir speaks of a cystic cavity the size of an egg in the head of the pancreas, representing a dilated duct, but this is decidedly an exception. I have not found in any of the reports mention of a widely disseminated microcystic condition of the pancreatic acini, such as was present in the case reported at the beginning of this paper (Fig. 3), though it would seem that such a condition would be a frequent result of partial obstruction of the main excretory duct.

It is remarkable that with the high degree of pancreatic atrophy and fibrosis frequently reported, in only one case—that of Schüller—was glycosuria mentioned as a prominent feature, and even in this instance it did not persist throughout the entire course of the disease. Rolleston, among others, calls especial attention to this fact. In his case many of the pancreatic ducts were dilated and contained calculi, and there was very advanced fibrosis, but no glycosuria. While undoubtedly in many of the reported cases no test for sugar was made, in by far the larger majority it is distinctly stated that this examination was carried out, and was found negative.

Treatment.—The only rational treatment for carcinoma of the papilla of Vater is radical extirpation, if this can be car-

ried out. It has been attempted, as has been said, in about 20 reported cases (Appendix A), with, it must be admitted, not very brilliant results so far. In these 20 cases, there were 8 primary deaths, and 12 patients recovered from the immediate effects of the operation. Of the latter, 5 are reported as subsequently dying, in 2 cases no data are given beyond the fact that primary recovery took place, and of the remaining 5, two are reported as well 7 months after operation, one 10 months, one 2 years, and one $3\frac{3}{4}$ years. As in all forms of carcinoma, early diagnosis is the *sine qua non*, but this is especially true in the type under consideration, owing to the rapidity with which a fatal termination may ensue. On the other hand, however, there is perhaps scarcely any form of malignant disease which so early sends out warning signals as that producing obstruction to the bile-ducts, signals that as a rule make themselves manifest while yet the growth is small, localized, and comparatively accessible.

In 14 of the reported 20 radical operations, the duodenum was opened by a longitudinal or transverse incision, and the growth, with a small amount of surrounding healthy tissue, excised, the bile- and pancreatic ducts being cut through, and then reimplanted into the duodenal wall. In one case the duodenum was opened, the growth simply curetted away, and the site cauterized, while in the remaining five cases resection of a portion of the duodenum was performed. Several authors advocate a two-stage operation, believing that the obstructive symptoms (cholæmia, etc.) should be relieved by a less serious procedure than radical extirpation of the tumor, which the patients are rarely in a condition to stand satisfactorily; this to be followed subsequently by the radical operation. Procedures of this sort have been reported by Mayo and Kausch; in the former's case the first operation was a cholecystostomy, in the latter's, cholecystenterostomy; in both instances primary recovery took place. For the first operation, Kausch does not favor simple cholecystostomy with drainage, for while this relieves the cholæmia, it causes too great a loss of important body fluids; he considers, therefore, a cholecystenterostomy the operation of choice for the first sitting, believing that this,

by conducting the bile and in some instances the pancreatic juice as well back into the intestine, places the patient in better condition to withstand the more serious operation later on.

Conclusions.—1. Carcinoma of the papilla of Vater, while by no means a frequently occurring condition, has been reported often enough to be of considerable clinical importance.

2. It may arise from one of several groups of cells, the exact point of origin having, however, little effect on the symptomatology, clinical course, or surgical indications.

3. The duration of the disease is comparatively short, the average time elapsing between the onset of symptoms and death being about seven months, and in many cases less than three months.

4. In most cases death results from cholæmia before metastasis or invasion of surrounding organs by the tumor has occurred.

5. Radical extirpation is technically possible, and if undertaken early enough should lead to a fair percentage of cures.

NOTE.—Since the completion of the above, two additional cases of radical operation have been reported, one by Upcott (*Ann. Surg.*, Nov., 1912), and the other by Slajner (*Zntlbl. f. Chir.*, 1912, xxxix, 259; also reviewed at some length in a recent article by Kausch; *Beitr. f. klin. Chir.*, 1912, lxxviii, 439). Upcott's case was a male, aged sixty-five years. The oval tumor, about the size of an olive, was removed through a transverse incision in the anterior duodenal wall, the edges of the common duct being then sutured to the duodenal mucosa. The patient recovered, but too short a time has elapsed to say anything of the ultimate result. Microscopically the tumor proved to be a columnar-cell adenocarcinoma.

Slajner's case was a male, aged forty-eight years. The small tumor was removed through a longitudinal incision in the anterior duodenal wall. The common and pancreatic ducts were then sutured to the duodenal mucosa. The patient died 36 hours later in collapse, with cholæmic hemorrhage. Microscopically the growth showed adenocarcinoma, arising from glands at the mouth of the papilla.

APPENDIX A.

Cases of Carcinoma at the Papilla of Vater which have been Subjected to Radical Operation.

The following abbreviations are used throughout Appendices A and B: **G.bl.**—Gall-bladder; **Com.d.**—Common bile-duct; **Pan.d.**—Pancreatic duct (Wirsung); **Pap.V.**—Papilla of Vater; **Dur.**—Duration of disease, from onset of first symptoms to death (or operation); **Op.**—Operation; **†**—Death.

ARNSPERGER:¹ Case 28: F., 43. Increasing jaundice for 6 weeks; g.bl. palpable. Op. (Voelcker). G.bl. distended; one stone size of a hen's egg. Nodule size of a walnut palpable in duod. at pap.V. Transverse incision of duod., tumor dissected out from surrounding tissue; 4 cm. of com.d. resected. Cut ends of com. and pan.d. implanted in duod. wall; duod. incision closed. **†** 2d day from hemorrhage (probably from pancreatic wound).

CORDUA:² F., 41. Jaundice; g.bl. palpable. Op. Carcinoma size of a 10-Pfg. piece found at pap.V. and excised. Com.d. sutured to post. wall of duod.; duodenal incision closed. Cholecystectomy. Gastro-enterostomy. Patient recovered, and gained in weight.

HALSTED:³ Case 2: F., 60. Jaundice; pruritus. Op. G.bl. and ducts greatly dilated; contained sand and clear fluid. Hard body felt at pap.V. A portion of the duod., with $\frac{3}{4}$ inch. of the com.d., and a shorter piece of the pan.d., resected; end-to-end anastomosis. Com. and pan.d. implanted into duod. along line of suture. Recovery; 3 mos. later 2d op. Anastomosis between duod. and g.bl. **†** Few mos. later. Autopsy: carcinoma had recurred in duod. and head of pancreas.

HARTMANN:²² Case 1: M., 60. Progressive jaundice; one slight remission. Op. (Navarro). G.bl. found dilated; com.d. size of thumb. Induration felt at pap.V. G.bl. aspirated; duod. opened. Tumor size of a pea found at pap.V. Circular incision around this, cutting com.d. 2 cm. and pan.d. 1 cm. above tumor. The two ducts then sutured together, and into intestinal wall. Patient recovered; well and strong two years later. Micr.: carcinoma, arising from ampulla.

Case 2: Jaundice for 3 weeks; g.bl. palpable. Op. (Cunéo). G.bl. and ducts found dilated. Circumscribed nodule felt at pap.V. Duod. accidentally torn; opening enlarged, and a firm mass size of an almond seen in Vaterian region, projecting into duod. lumen. Lozenge-shaped incision around this, removing it, and cutting through pancreatic tissue. Com.d. sutured into upper portion of duod. incision; lower portion closed; middle portion left open, and cut surface of pancreas brought into it. Posterior gastro-enterostomy. **†** 5th day. Micr.: carcinoma, arising from terminal portion of com.d.

HOTZ²⁴ (also **OPPENHEIMER**²⁵): F., 61. Progressive jaundice for 7 months; pruritus; pains in gastric region. Op. (Hotz). G.bl. and ducts found distended. Tumor 5 cm. in length felt at opening of com.d. into duod. Post. gastro-enterostomy; then longitudinal incision in ant. duod. wall. Papilla found enlarged to a mass size of thumb; this was pulled

forward, and incised around the base; com. and pan.d. dissected free for about 4 cm., then cut across. Cut edges of these sutured to duod. mucosa; incision in duod. closed. Patient well and able to work 7 mos. later. Micr.: adenocarcinoma, arising from lower end of com.d.

KAUSCH:²⁵ M., 49. Jaundice for 6 weeks. Op. G.bl. size of fist; nodule size of a pea palpable at pap.V. Cholecystenterostomy and entero-anastomosis. Jaundice disappeared. Two mos. later 2d op. Gastroenterostomy; closure of pylorus. Duod. then shelled out from above downward; piece of the pancreas size of a walnut resected, cutting through pan.d. in substance of pancreas. Duod. cut through at junction of pars inferior and descendens; cut end of remaining duod. drawn like a cap over cut surface of pancreas, and held by catgut sutures, the com.d. also being brought into duod. lumen. Recovery; † 9 mos. later from cholangitis.

KÖRTE:²⁶ F., 44. Jaundice; colicky pains. Op. G.bl. and com.d. both found enlarged; no stone. Duod. incised; tumor size of a small cherry found blocking exit of com. and pan.d. Tumor and surrounding mucosa excised; com. and pan.d. sutured to duod. wall. † 8th day. Micr.: adenocarcinoma.

KÖRTE:²⁶ F., 52. Jaundice, pains, fever, malaise for 14 weeks. Op. G.bl. and ducts much enlarged; contained pus. Induration and stenosis felt at opening of com.d. into duod., but no tumor. Duod. incised; the stenosed com.d. opening slit up; com. and pan.d. drained. Patient well for 1½ yrs., then jaundice returned. 2d op. Hard nodule size of a bean felt at mouth of com.d. Circular resection of duod., with end-to-end anastomosis. Com. and pan.d. cut through, sutured together, and then into post. duod. wall. † 3d day. Micr.: adenocarcinoma.

KÖRTE:²⁶ Case 32: F., 47. Jaundice for several months; pruritus; palpable tumor in liver region. Came to hospital on account of fracture of tibia. Op. G.bl. and ducts found much dilated; contained thick sand, but no stone. Longitudinal incision of duod.; hard tumor size of little finger at pap.V. Tumor excised; com.d. sutured to duod. mucosa. Patient well 3¾ yrs. later. Micr.: carcinoma of terminal portion of the com.d.

MAYO:²⁷ F., 59. For many years sudden attacks of pain in epigastric region, lasting several hours, and ending with vomiting; sometimes jaundiced during these attacks. For 1 yr. loss of weight and appetite; moderate jaundice. Op. G.bl. enlarged; contained one stone size of a pea. Com. and cystic ducts moderately dilated. Cholecystostomy; jaundice disappeared, but stools remained acholic. Three mos. later 2d op. Hard mass size of a filbert felt through duod. wall at end of com.d. Incision in ant. duod. wall, exposing a grayish-white mass limited to pap.V. Excised; raw surface cauterized. Duod. closed. Recovery. Micr.: cylindrical-cell carcinoma.

In a subsequent paper, the Mayos²⁸ state that they "have had several examples of primary carcinoma at the pap.V., with two primarily successful excisions, but no case has lived beyond 3 years."

MAYO-ROBSON:²⁸ Case 536: M., 30. Three years previous, abdominal pain and jaundice for 4 weeks; 3 mos. later pain again, but no jaundice. Since then several attacks of pain, without jaundice. Op. A growth,

which had evidently started in region of pap.V., found involving inner portion of duod., whence it had extended to pylorus and head of pancreas. In separating adhesions a perforation of duod. discovered which could not well be closed; portion of duod. and pylorus resected; duod. and stomach united by sutures. As it was clear that the com.d. would be obstructed, g.bl. drained, with view to subsequent cholecystenterostomy. † Few days later.

MORIAN: ⁴⁰ Case 4: Sudden onset of jaundice; pruritus. Op. G.bl. found distended; com.d. size of thumb. Tumor size of hazel-nut felt at pap.V. Cholecystenterostomy; then longitudinal incision in ant. duod. wall. Circular incision around tumor; com. and pan.d. cut through; tumor mass removed; both ducts sutured into duod. wall. Incision in duod. closed. Recovery; 10 mos. later patient apparently well, had gained over 20 lbs., and was able to do ordinary housework. Micr.: carcinoma.

OEHLER: ⁴⁰ F., 60. Pains in gastric region; jaundice; pruritus. G.bl. palpable as pear-shaped mass. Dur. 5 mos. Op. (Kraske). G.bl. incised and emptied. Com.d. found distended; incised. No stone, but obstruction felt at pap.V. Transverse incision in ant. duod. wall; a hard, papillary tumor, slightly ulcerated, size of a hazel-nut, found completely surrounding opening of com.d. Tumor excised, keeping well in healthy tissue; bed cauterized. Com.d. and duod. sutured together; duod. and com.d. incisions closed. No metastases found. Recovery. Micr.: adenocarcinoma, arising from duod. mucosa.

OPPENHEIMER: ⁴⁰ F., 63. Jaundice and gastric pain for 3 mos. Op. (Enderlin). G.bl. and cystic duct distended with clear fluid. Hard nodule size of a hazel-nut felt in region of head of pancreas, and a gland size of a cherry, at junction of cystic and hepatic ducts. Com.d. incised; stenosis found at pap.V. and cut through. A circumscribed tumor found adherent to duod. wall and pancreas. Whole of com.d. and surrounding indurated area resected; hepatic duct sutured to duod.; cholecystectomy. Stump of pan.d., which had also been cut through, sunk in duod. wall. Micr.: adenoma, arising from gall-ducts. Recovery; in 1 mo. patient had gained 15 lbs. † 1 yr. later from recurrence in liver.

RIEDEL: ⁴⁰ F., 50. For 9 months sharp attacks of pain in upper abdomen; for 6 months progressive jaundice. Op. G.bl. and ducts found much dilated, and filled with clear fluid. A yellowish-white tumor, size of a hazel-nut, at pap.V. Com. and pan.d. cut through; duod. resected, and the two ducts sutured into duod. wall. † Same day from shock (advanced pulm. tbc.).

RIXFORD: ⁴⁴ F., 33. Jaundice for 4 months; sudden onset. Op. Mass felt in region of papilla; duod. opened by longitudinal incision, and a portion of the mass removed. Field of operation immediately flooded with bile. Duod. incision closed; g.bl. drained. Micr.: adenocarcinoma. One month later 2d op. Remainder of the little tumor excised, with adjacent portion of duod., 1½ inch of com.d., and 2 enlarged retroperitoneal lymph-nodes. Patient well for 8 months, then jaundice recurred. 3d op. Cholecystenterostomy. † 4 mos. later.

SCHÜLLER ⁴⁶ (also ARNSPERGER,¹ Case 27): Case 1: M., 66. Progressive jaundice for 6 months; chills; fever; glycosuria, which, however, only

lasted 4 weeks. Op. (Czerny). Icteric ascites. G.bl. contained 150 c.c. mucopurulent fluid; aspirated. A hard body size of a date-seed felt at pap.V. Longitudinal incision in ant. duod. wall; the little tumor, which appeared ulcerated, seized with forceps and drawn forward. Circular incision around it removing it in 3 pieces. Cut end of com.d. sutured to edge of duod. mucosa; tube placed in g.bl.; duod. incision closed. † 5th day from sepsis. Micr.: adenocarcinoma, arising from com.d., duod., or pancreas (?). Metastases in liver.

STEIN:¹¹ F., 37. Attacks of pain in gastric region; vomiting; jaundice, with free intervals. Palpable, tender tumor in g.bl. region. Op. G.bl. much dilated; com.d. size of small intestine. Duod. opened; an area of 5 sq. cm. on post. wall found covered by a soft, friable, papillary tumor mass, surrounding pap.V. This curetted away, and site cauterized. Duod. closed. Patient recovered, and was well 7 mos. later. Growth considered a benign adenomatous proliferation of mucosa.

VERHOOGEN:¹² F., 33. Sudden onset of jaundice; pain in right hypochondrium; vomiting. Dur. 8 months. Op. G.bl. size of a pear; no stones. Incision in ant. duod. wall. Little soft, fungoid tumor found covering pap.V.; resected; com.d. sutured to duod. mucosa. † 10th day. Micr.: glandular elements without atypical formation, "hence adenoma."

APPENDIX B.

Cases of Carcinoma at the Papilla of Vater without Radical Operation.

ARNSPERGER:¹ Case 30: M., 56. For 1¼ yrs. jaundice in varying degree. G.bl. enlarged; many small stones. Com.d. dilated; head of pancreas hard, size of an egg. Cholecystenterostomy. † 12th day. Autopsy: stenosis at pap.V. Micr.: scirrhous carcinoma of pap.V.

AVEZOU:² M., 72. Intense jaundice, with slight remissions; pruritus; constipation. G.bl. size of child's fist; com.d. size of index-finger. A circular, fungoid plaque, with raised edges, size of a 2-sou piece, found in duod. at level of pap.V., not, however, completely occluding orifice of com.d. Pancreas hard; no carcinoma. Dur. 8 mos.

CADE and LERICHE:⁴ M., 46. Intense jaundice; occult blood in stools. Cholecystogastrostomy; 11 days later gastro-enterostomy; 5 weeks later exploratory op.; † 4th day after. G.bl. much dilated; com.d. size index-finger. Hard nodule size of a walnut on pancreatic edge of duod. at level of pap.V. Pancreas hard, prob. neoplastic. Dur. 6 mos.

CARNOT and HARVIER:⁵ Severe, progressive jaundice; pain in epigastric region. Watery fluid in g.bl. Projecting from pap.V. a tuft of long, delicate villousities, attached to a neoplasm developed in lower end of pan.d. Micr.: carcinoma, originating from epith. cells of pan.d., presenting toward the lumen a villous, deeper an adenocarcinomatous structure.

COATS and FINLAYSON:⁶ M., 48. Intense jaundice; sudden, severe pain in region of g.bl. 1 wk. before death. G.bl. greatly distended and perforated; com.d. 1¼ inches in diam. At terminal portion of com.d. a soft, prominent mass, partly ulcerated. Micr.: carcinoma, arising from com.d.; duod. mucosa not affected. Dur. 10 mos.

DEVIC and SAVY:⁹ M., 52. No jaundice. Umbilical pain after eating; vomiting. Gastro-enterostomy; † 36 hrs. later. G.bl. not distended; several stones. Com.d. size of a lead pencil. Annular tumor in duod., beginning 4 cm. from pylorus, and extending for 14 cm. Oldest portion apparently corresponds to site of pap.V. Micr.: encephaloid cancer, with superficial ulceration arising from intestinal mucosa. Pancreas normal, but surrounded by a mass of neoplastic glands. Dur. 4 mos.

DOMINICI:¹⁰ M., 70. Progressive jaundice; hiccough; tenderness in g.bl. region. G.bl. and all ducts distended; filled with clear mucoid fluid. A cone-shaped mass, 1 cm. in diam. at the base, and 1.5 cm. high, found projecting from pap.V. Micr.: cylindrical-cell carcinoma, arising from ampulla, com.d., and pan.d. Pancreas: dilatation of many ramifications of the ducts; irregularly disseminated atrophy of the acini; interstitial sclerosis. Dur. 6 mos.

DURAND-FARDEL:¹¹ M., 58. Sudden onset of jaundice, then progressive. G.bl. enormously dilated; walls thick. Com.d. forms a pouch 2 cm. in diam. where it joins the duod.; size of little finger above this. A round, hard, whitish mass, size of a cherry-stone, found projecting into com.d. exactly at the point where this enters the intestinal wall. Micr.: cylindrical-cell carcinoma, arising from the surface epithelium of the "canal ampullaire." Dur. 6 mos. (This case is considered by Bard a cancer of the pancreas, by Rendu an intestinal cancer, by Hanot a cancer "pancréatico-biliaire," and by Durand-Fardel himself a primary cancer of the bile-ducts.)

EDES:¹² F., 48. Sudden onset of jaundice. G.bl. enlarged; many whitish stones. Com.d. enormously dilated to within 2 inches of duod., where an abrupt narrowing takes place; a small lymph-node found pressing on wall of com.d. at this point. No definite mass discernible macroscopically at pap.V. Micr.: carcinoma of pap.V. at orifice of com.d.; lymph-gland secondarily involved. Dur. 16 mos.

ELOESSER:¹³ M., 56. Intermittent jaundice. G.bl. moderately enlarged; walls thin; few mulberry stones. Cholecystenterostomy; † 13th day in collapse. Com.d. dilated. An indurated mass projects into duod. at orifice of com.d. Micr.: carcinoma, arising either from duod. mucosa, lower portion of com.d., or an accessory pancreas. (The author considers aberrant pancreatic acini in the wall of the com.d. the most probable source of origin, but does not bring forward any very convincing reasons for this belief.)

ELY:¹⁴ M., 53. Progressive jaundice; fever; pain and tenderness over liver. G.bl. and com.d. greatly distended; filled with whitish, puriform fluid. Cholecystostomy; † 10th day from hemorrhage. A little nodular tumor, 11 × 9 mm., at mouth of com.d., completely surrounding it, and narrowing the lumen. Micr.: cylindrical-cell carcinoma, arising from com.d. Pancreas: interstitial pancreatitis. Dur. 4 mos.

HALL:¹⁵ M., 46. Intense jaundice; fever. G.bl. dilated; thin, pale bile. Com.d. size of little finger. At pap.V., beneath duod. mucosa, a mass size and shape of a small bean, surrounding entire lumen of com.d., but not invading the deeper structures. Dur. 5 mos.

HANOT:¹⁶ M., 40. Progressive jaundice, with slight remissions;

fever; sweats; pruritus; diarrhoea. G.bl. slightly dilated, and filled with clear fluid; com. and pan.d. dilated. At level of pap.V. a mass, size of a chestnut, projecting into intestinal lumen, surrounding opening of com.d. Micr.: cylindrical-cell carcinoma, prob. arising from intestinal mucosa. Dur. 18 mos.

HANOT:²¹ F., 58. Rapidly increasing, finally bronzed jaundice; pain in back; pruritus. G.bl. not dilated; com.d. enlarged to diam. of 5 cm. in lower portion, about normal in upper. A mass, the form and size of a cherry, exactly at pap.V., projecting into intestinal lumen. Micr.: cylindrical-cell carcinoma, arising from wall of ampulla only; intestinal mucosa normal. Dur. 10 mos.

HARTMANN:²² Case 3: M., 61. Jaundice, pains, fever, sweats; all intermittent. One stone in com.d.; removed. † 8th day (pulm. tbc.). A mass size of an almond at pap.V., extending 2.5 cm. into com.d. Micr.: villous carcinoma, infiltrating duod. wall; origin, com.d. Dur. 1 yr.

HERRICK:²³ M., 66. Sudden onset of jaundice, then progressive; soreness at right costal margin. G.bl. and all ducts greatly dilated. A mass of dense white tissue, about 2.5 cm. in diam., localized at pap.V., occluding all the entering ducts. Micr.: adenofibroma. Dur. 2¼ yrs.

KAUSCH:²⁴ M., 74. Progressive jaundice; pruritus; ascites. G.bl. size of fist and lower third of forearm; filled with clear fluid, likewise the com.d. Cholecystostomy; 5 weeks later cholecystenterostomy; † 3 weeks later. At pap.V. a tumor size of a small cherry, almost pedunculated, hanging free in intestinal lumen; pedicle formed from drawn-out intestinal wall.

KLOTZ:²⁵ Case 1: M., 62. Deep jaundice; constipation; nausea; vomiting; pain over liver. Com.d. size of thumb. The bile papilla projects as a firm, even mass into the duodenal lumen. Micr.: columnar-cell carcinoma of pap.V. Pancreas atrophic, with dilatation of pan.d. Dur. 6 mos.

Case 2: M., 40. Progressive jaundice; nausea; vomiting; pain in abdomen and back. G.bl. partially distended with dark, fluid bile. Com.d. distended and tortuous; constricted at several places by infiltrated glands. Site of the bile papilla the seat of a shaggy, necrotic ulcer, 3 × 2 cm., through which com.d. passes. Micr.: adenocarcinoma, arising from glands of Brunner. Pancreas indurated; a few of the outermost lobules invaded by the tumor. Dur. 8 mos.

LE BLANC:²⁶ F., 71. Progressive jaundice; fever. G.bl. much enlarged. Mass at entrance of com.d. into duod., involving head of pancreas and pap.V. Micr.: carcinoma. Dur. 8 weeks.

LENORMANT:²⁷ F., 68. Jaundice, at first intermittent, later progressive; pruritus; pain in right hypochondrium. G.bl. size of a small egg-plant; com.d. size of the thumb. Both filled with clear fluid. Cholecystectomy; † 1 week later from anuria. A small, well-defined tumor found at pap.V. Micr.: cylindrical-cell carcinoma, apparently arising from intestinal epithelium. Dur. 4 mos.

LETULLE and VERLIAC:²⁸ F., 68. Sudden onset of jaundice; diarrhoea; severe abdominal pain toward the end. G.bl. enormously distended with yellowish bile and gravel. Com.d. very narrow at terminal portion,

but passable for a fine probe; pan.d. completely obstructed. Tumor size of a pea found completely surrounding the pan.d. at its lower end, with slight extension to wall of com.d. Micr.: carcinoma, arising from terminal portion of pan.d. Pancreas indurated, atrophic; duct dilated throughout. Dur. 6 mos.

LINDNER:³³ Case 1: M., 50+. Intense jaundice; frequent colics. G.bl. enlarged; numerous stones. Small primary carcinoma in duod. portion of com.d. Dur. few weeks. Case 2: M., 60+. Symptoms and findings same as Case 1. Dur. several months. Case 3: M. Intermittent jaundice; pruritus. Cholecystenterostomy; † 5th day (cholæmic hemorrhage from stomach). Small carcinoma found at pap.V. Case 4: F., 56. Intermittent jaundice; colics. G.bl. moderately enlarged, com.d. much dilated; both filled with many large stones. Cholecystostomy; at 2d op. fistula closed; † 2 days later. Small primary carcinoma found in duod. portion of com.d.

MARTHA:³⁷ M., 60. Intense jaundice; severe abdominal pains; vomiting. G.bl. 19 cm. long; com.d. size of index-finger; both filled with clear fluid. Second portion of duod. transformed into a tumor size of the fist, most prominent at pap.V. Head of pancreas also cancerous. Origin probably pap.V., with secondary involvement of pancreas. Dur. 5 weeks. (Owing to the large size of this tumor, and lack of microscopic examination, its nature must be considered undetermined.)

MAY:³⁸ M., 67. Intense jaundice; abdominal pain last two days before death; pruritus. G.bl. perforated and collapsed; com.d. enormously dilated. Many small, blackish stones in g.bl., cystic and com. ducts. At mouth of com.d. a hard, ring-like tumor, size of a cherry, partly projecting into the duodenum. Micr.: cylindrical carcinoma, arising from duod. end of com.d. Metastatic nodules in liver. Dur. 1 yr.

MCNEAL (GEDDINGS):⁴⁰ Case 2: M. Universal jaundice, with slight remissions; vomiting; purging. G.bl. enormously distended; com.d. size of middle finger; stones in both. Mass in portion of duod. which is entered by com.d., completely occluding this; the mass shows "encephaloid degeneration," and is ulcerated toward the intestinal lumen. Trunk and primitive bifurcations of the portal vein completely occluded by encephaloid matter. Head of pancreas enlarged and hard.

MORAX:⁴⁴ F., 78. Progressive jaundice. G.bl. and com.d. dilated, and filled with thick, black bile. Hard nodule size of a bean in duod. wall at mouth of com.d. Micr.: cylindrical-cell carcinoma, arising from duod. mucosa. Dur. 3 weeks.

MORIAN:⁴⁶ Case 1: F., 63. Progressive jaundice. G.bl. markedly enlarged; many small stones. Com.d. dilated, and filled with a yellowish-white tumor mass, which extends up into hepatic duct. Micr.: carcinoma. White nodules in liver (metastases?). Dur. 4 mos. Case 2: M. 69. Jaundice; abdominal pains; ascites. Cholecystostomy. Six weeks later cholecystenterostomy; † 2d day. Autopsy: com.d. dilated; wall thickened for a distance of 1 cm., beginning just above pap.V. Dur. 5 mos. Case 3: F., 54. Jaundice, intermittent in intensity, pruritus. G.bl. shrunken; one stone. Com.d. size of thumb. Cholecystenterostomy.

At operation a tumor felt on post. wall of duod. at pap.V., resembling male nipple; head of pancreas also hard and nodular. Considered a neoplasm of pap.V., which had invaded pancreas. Recovery; † 1¼ yrs. later with signs of general metastasis. Dur. 1¾ years.

OESTERREICH:⁴⁷ M., 39. Intense jaundice. G.bl. and com.d. much dilated. Tumor at pap.V. size of a small apple. Micr.: cylindrical-cell carcinoma. A few metastases on surface of liver and in celiac glands.

RENDU:⁶² M., 53. Intermittent jaundice; epigastric pain; fever; headache. G.bl. enlarged, filled with mucus; cystic duct obliterated. Com.d. 3 cm. in circumference; contains bile and pus. Exactly at position of pap.V. a plaque 3.5 × 2 cm., slightly elevated above the intestinal mucosa. Micr.: cylindrical-cell carcinoma, resembling those of intestinal origin; does not extend beyond submucosa. Small metastatic nodule in liver. Dur. 4½ mos.

ROLLESTON:⁶⁵ M., 66. Jaundice; pruritus. G.bl. and all ducts greatly dilated; com.d. size of thumb. Flat growth found limited to pap.V., occluding the orifices of the com. and pan.d. Micr.: columnar-cell carcinoma, invading the smooth muscle tissue around the pap.V. Pancreas: fibrosis; ducts dilated. Dur. 11 weeks.

SEARS:⁶⁷ M., 49. Progressive jaundice; pruritus; constipation. Patient had had an attack of catarrhal jaundice 18 years before. At operation g.bl. found distended, and full of viscid fluid; † 2 days later. Autopsy: tumor size of a pea found at pap.V., completely occluding it. Dur. few weeks.

SHEPHERD⁶⁸ (also DUVAL⁷⁰): M., 44. Progressive jaundice; pruritus. G.bl. distended with thick, dark bile; com.d. three times normal size. Cholecystostomy; † 5 weeks later from exhaustion. In lower portion of com.d. a soft, brownish-black, fungoid mass, 2.5 cm. long, completely occluding the lumen of the com.d.; entirely confined to com.d. and ampulla. Micr.: composed almost entirely of pigmented cells, but structure resembles in many ways that of epithelioma. Origin, apparently tunica propria of com.d. and ampulla. Diagnosis: "melanoma." Dur. 3½ mos.

SOUQUES and AYNAUD:⁷² Case 1: F., 43. Jaundice; cough; expectoration. G.bl. dilated; com.d. size of index-finger. A hard tumor, size of a pea, at pap.V. Com.d. passes through the tumor, but is not completely obstructed. Micr.: cylindrical-cell carcinoma, arising from ampullary portion of com.d. Metastatic nodules in liver and lungs. Dur. several weeks. Case 2: M., 72. Progressive jaundice; pruritus; abdominal colics; diarrhœa. All ducts dilated. At pap.V. a round tumor, somewhat smaller than in Case 1, pushing up duodenal mucosa. Micr.: cylindrical-cell carcinoma, infiltrating walls of com.d. and completely obstructing its lumen. Dur. 3 mos.

STABEL:⁷⁰ M., 50. Intense jaundice; chills; pain in liver region. G.bl. greatly distended. Cholecystostomy; † from abscess in kidneys and prostate. Primary carcinoma found in com.d. at its opening into duod.

STOKES:⁷³ M., 68. Deep jaundice; fever; chills; pruritus; constipation. Distinct remissions in all these symptoms from time to time.

G.bl. and com.d. greatly distended; walls of former thickened. Orifice of com.d. in duod. surrounded by an irregular fungus, resembling an old cicatrix. Dur. 1½ yrs.

THOMAS: ⁸⁸ F., 53. Persistent jaundice. All ducts much dilated, and filled with puriform fluid. At pap.V. a tumor, ulcerated toward duod. Micr.: cylindrical-cell carcinoma, arising from the ampulla, or (according to Letulle) from the intestinal mucosa covering this. Dur. 4 mos.

WEIR: ⁸⁹ M., 35. Very marked jaundice; pain in liver region. G.bl. and all ducts dilated. Cyst in pancreas drained; 10 days later cholecystenterostomy; † 2 hours later. A soft tumor, 3 cm. in length, of cauliflower appearance, found rising slightly above intestinal mucosa; in centre of this, the opening of the com.d. and pan.d. Micr.: carcinoma. Dur. 7 weeks. (Lannois and Courmont consider this a case of carcinoma of the pancreas.)

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TENDON FIXATION.

A PRELIMINARY REPORT OF A SIMPLE OPERATION FOR THE PREVENTION
OF DEFORMITY IN PARALYTIC TALIPES..

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DISSATISFACTION with the results obtained from arthrodesis, tendon transplantation and silk ligament installation led to the trial of the method which is here reported.

CASE I.—A. W., a boy eight years of age, had had anterior poliomyelitis six years ago, resulting in permanent complete paralysis of the right peronei muscles and partial paralysis of the dorsiflexors of the foot. Equino-varus resulted which was corrected in October, 1909, by forcible manipulation and tenotomy of the tendo Achillis. A stop joint ankle brace with an outside T strap was applied after the removal of the plaster of Paris and a splint was worn at night. Two years later the patient returned to the hospital with a recurrence of the varus deformity. The dorsiflexors had regained fairly good power and there was no further tendency to toe drop. Arthrodesis was then performed at the astragalo-navicular and calcaneo-cuboid joints, the varus being completely corrected. The operation resulted in solid union. Six months ago the patient returned to the hospital with a marked recurrence of the varus, the deformity occurring at the ankle joint. The ankylosis at the midtarsal joint was still quite firm, and as far as this joint was concerned, the contour of the foot was correct. The whole of the deformity was due to the pulling of the astragalus out of its socket. To overcome this deformity and to prevent its recurrence the following operation was performed.

A vertical incision, three inches in length, was made on the outer side of the leg, over the peronei tendons, extending downward to below the styloid process of the fibula. The tendon of the peroneus longus was freed by division of the upper part of

the external annular ligament, and displaced sufficiently far forward so that traction upon it produced dorsiflexion. With the tendon in its normal position, traction upon it would produce plantar flexion. A vertical incision two and a half inches long was then made through the periosteum of the anterior surface of the fibula down to the lower extremity of the bone. The periosteum was elevated for a quarter of an inch on either side of this incision and with a gouge a piece of bone, two and a half inches long and of the thickness of the peroneal tendon, was removed from the fibula. With the assistance of a pair of Kocher's clamps the tendon was drawn taut, thus dorsiflexing and abducting the foot, and the tendon laid in the trough prepared for it. Here it was securely fastened by a No. 1, thirty day chromic catgut suture, which caught the two edges of the periosteum and the tendon itself, completely covering the tendon with the periosteum for a distance of two and a half inches.

A similar vertical incision was made in the periosteum under the peroneus brevis, and this tendon treated as was the peroneus longus. The external annular ligament was now sutured with catgut and the skin closed with horse-hair. The foot was held in this correct position by a plaster of Paris bandage.

The reason for displacing the tendon of the peroneus longus forward was to prevent the production of a fixed equinus from the tightening of these tendons. By the new arrangement the action of the two peronei tendons balanced each other.

A month after the operation the plaster was removed. Healing had occurred by primary union and the foot was in good position and held firmly by the fixed tendons, although the strength of the fixation was not severely tested. Plaster was reapplied.

Nine weeks after the operation the plaster was again removed and the foot found to be held firmly in a correct position by the fixed tendons. The fixation was quite solid, as demonstrated by the fact that strong attempts to adduct the foot were unsuccessful. The range of voluntary and passive dorsiflexion was normal, while that of plantar flexion was limited about one-half by the fixed tendon.

For the past two months the patient has been walking without a brace and there has been no tendency to recurrence and so far the operation has been successful.

This operation has been performed on three other patients. One was a case of varus, similar to the case above; one was a case of equino-varus, with complete paralysis of the dorsi-flexors as well as of the peronei; and the last was a case of equino-valgus, there being complete paralysis of the dorsi-flexors and adductors of the foot.

Case No. 2 was identical with Case No. 1, except that in the former no previous operations had been performed.

In Case No. 3, in addition to the fixation of the peronei tendons, a similar fixation was performed on the tendon of the tibialis anticus, the tendon being buried under the periosteum of the tibia, on its anterior border. It is now four months since the operation, and there is no tendency to recurrence of the varus and plantar flexion is not possible past a right angle, owing to the fixation of the tendon of the tibialis anticus.

In Case No. 4 it was necessary to do a tenotomy of the peronei tendons as well as of the tendo Achillis. A fixation was **then performed on the tibialis anticus** as in Case No. 3, and in addition the tibialis posticus was dealt with in a similar manner, being buried under the periosteum of its own groove. The patient is now walking about with the assistance of a Whitman flat foot brace and as yet there is no tendency to recurrence of either valgus or equinus.

It is not to be expected that as much can be achieved by an operation such as that performed in Case No. 4, where the fixed tendon has to support the body weight, as from those operations in which the fixed tendon has simply to support the weight of the foot or to resist the tendency to contracture of antagonistic muscles.

In none of the cases has a longer time than five months elapsed since the operation, so that in no sense can this report be considered a report of final results. But if the fixation holds and the tendon does not stretch, this operation has the advantage of preventing the deformity in a manner which most closely resembles normal conditions. The results so far obtained are sufficiently encouraging to warrant a further investigation of this method of treatment.

THE END RESULT OF EXCISION OF THE ELBOW FOR TUBERCULOSIS.

BY T. WINGATE TODD, M.B., F.R.C.S.,

OF MANCHESTER, ENG.,

Lecturer in Anatomy in the University of Manchester.

MY excuse, as an anatomist, for intruding on the domain of surgery in the clinical investigation of tuberculous joints, is the discrepancy in accounts by various writers of what is ultimately the state of the joint in the cure after operation on tubercular disease of the elbow. One rarely has the opportunity of thoroughly investigating the condition of a cured tuberculous elbow which has undergone treatment by excision. Such an opportunity having occurred in the department of clinical anatomy in the University of Manchester, I venture to give an account of the pathology of the case, in the hope that it may be of service to clinical investigators of tubercular disease of this joint.

In his recent book on joint tuberculosis Ely brings forward the suggestion that tubercular disease of a joint is invariably a disease of the synovia and red marrow.¹ On page 95 he states the following regarding the radical treatment of tubercular joints:

If the cure can be brought about by ankylosis or by dislocation, it . . . is not anything in ankylosis itself that brings it about but it is essentially the destruction of the joint.

The synovia and red marrow owe their presence here to function in the joint, and if function be removed they disappear. If they disappear, the disease cannot exist in that locality. Without them there can be no such thing as joint tuberculosis. . . .

Of the elbow . . . my specimens do not enable me to speak positively. Probably the matter stands as in the hip, that is, cure by fibrous union or by bony ankylosis.

Again, on page 175, this author makes the following statement in his description of tuberculosis of the elbow-joint:

¹ Ely: Joint Tuberculosis, 1911.

It would be interesting to find out whether the existence of a true joint here disputes our theory (*i.e.*, the formation of fibrous tissue which is immune) or whether, as in the ordinary cured tuberculous hip, there is really no joint at all and the bones are simply tied together by fibrous tissue.

Such a theory as that of Ely is a decided step forward in the better understanding of tuberculous joints, if it is found to be borne out by future investigations.

I do not attempt to criticise Ely's views on the subject, but merely to point out that an elbow may be completely cured of tuberculosis and yet not exhibit obliteration of the joint cavity and its replacement by fibrous tissue.

During the present year M. M., a female subject aged fifty-nine, was delivered to the anatomical department of the University of Manchester for purposes of dissection. As the body showed tubercular lesions and also the scar of old operation on the right elbow, it was handed over to the department of clinical anatomy for investigation.

Examination showed that there were active tubercular lesions in the right tarsus and the right side of the frontal bone. Considerable necrosis had occurred in the latter area and death was due to an abscess of mixed infection in the right frontal area of the brain. There was no sign of phthisis in the lungs, and the pleuræ showed complete absence of adhesions. Apart from the elbow the body exhibited no lesions worthy of note other than those just mentioned.

The patient had, at some previous date—which unfortunately was not ascertained in the hospital—suffered from tuberculous disease of the right elbow-joint and had undergone an operation for excision, concerning which no further details could be obtained. The operation had been entirely satisfactory. The disease had been completely eradicated, and the patient possessed a flail elbow, the arm and hand being still of service to her. The incision used had been a longitudinal one on the posterior and inner aspect of the joint—parallel to the course of the ulna nerve. This incision had been modified to a bayonet type by a smaller transverse cut on the extensor surface at the level of the lowest portion of the humerus. On making longitudinal sections of the

joint the operation was found to have partaken of the nature of partial, rather than of complete, excision. The olecranon had been entirely removed, together with the articular surface of the humerus. The coronoid process and the head of the radius had been left *in situ*. A joint cavity was found and contained a small amount of glairy synovial fluid. The portions of bone left had undergone osteoporosis and showed yellow marrow only. No osteophytic growths were present. The lower end of the humerus overlapped the ulna by 3.5 cm.

Fig. 1 shows a longitudinal section through the joint, while Fig. 2 is an illustration of a similar section made through the healthy left elbow-joint for comparison with Fig. 1. Dense fibrocartilaginous tissue covered the wasted coronoid process and head of radius. The capsular ligaments had been little interfered with except behind. Adhesions were numerous in the superior radio-ulnar joint. Synovial membrane appeared to line the joint cavity. Histological sections were therefore made to ascertain whether tubercle were still present and whether synovial membrane really did exist. The following is the result of the microscopic examination:

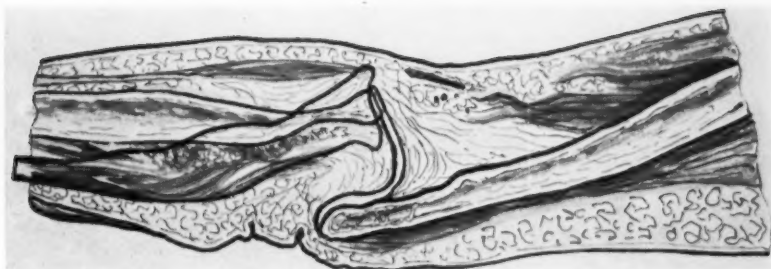
Sections of the joint lining adjacent to the sites where bone had been excised show a lining of synovial membrane and the formation of synovial villi. No giant-cells are present, the nearest approach to them being such an appearance as that figured at *a*, Fig. 3.

This, however, on closer inspection proves to be part of the wall of an obliquely cut blood-vessel. No lymphocytes are present in the tissues. Amyloid degeneration is nowhere to be found, though it was specially sought for. The walls of the blood-vessels are thickened and from the reaction of this tissue to eosin and acid fuchsin, it appears to be hyaline in character.

Thus the joint shows regeneration of synovial membrane and no evidence of active tubercular disease. Indeed the presence of hyaline degeneration is the only appearance which could be connected with the presence of old cured tuberculosis.

The result of the investigation of this case is not so satisfactory as could have been wished. This is the natural result of an incomplete operation. The case shows, however, that the cure of a tuberculous elbow by excision need not necessarily involve total destruction of the joint and its replacement

FIG. 1.



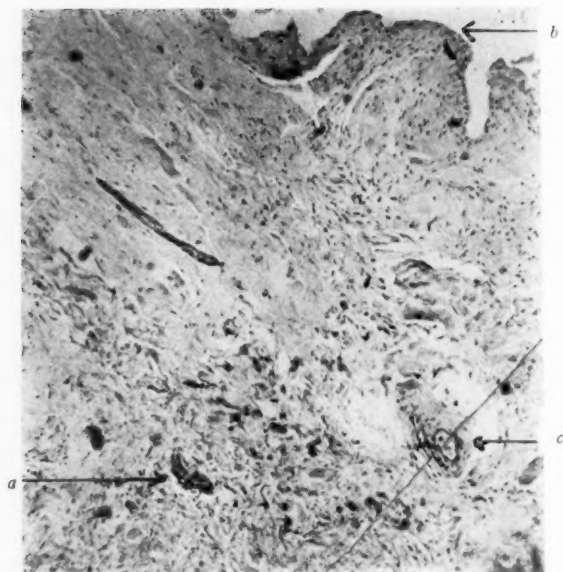
Anteroposterior longitudinal section through the right elbow-joint. The ulna has been outlined on the illustration to show its general appearance and its position relative to the radius. Lateral half of elbow region.

FIG. 2.



Anteroposterior longitudinal section through the normal left elbow-joint for comparison with Fig. 1. Mesial half of elbow region.

FIG. 3.



Section through joint lining at edge of resected bone. *a*, blood-vessel wall cut obliquely and simulating giant-cell formation; *b*, synovial edge; *c*, vessel cut transversely with some hyaline change.

by fibrous tissue. The age of the patient interferes with any inference drawn from the character of the marrow.

I am not disposed to regard this case as a controversion of the views suggested by Ely, in defence of which he has brought forward so much evidence.

I have described the case in view of the fact that it exhibited a healed tuberculous elbow in which a joint cavity was still present, and because opportunities of investigating such joints are comparatively rare.

Professor Elliot Smith kindly placed the subject at my disposal, and Professor Lorrain Smith gave me much useful criticism on the histology of tuberculous joints. To both of these gentlemen I would therefore acknowledge my indebtedness.

SUMMARY.

The end result of partial excision of the elbow-joint for the cure of tuberculosis may be perfectly successful and yet a joint cavity may remain.

The cure of such a case does not necessarily depend on the obliteration of the joint cavity and its replacement by fibrous tissue.

THE ARREST OF HEMORRHAGE FROM BONE BY PLUGGING WITH SOFT TISSUES.*

BY GEORGE TULLY VAUGHAN, M.D.,

OF WASHINGTON, D. C.

THIS method of arresting hemorrhage was first used by me some ten years ago, and I desire again to invite the attention of surgeons to its simplicity and efficiency. I have used it with satisfaction in a great many operations where bleeding from the bone was troublesome, as in fractures of the skull, sections of the skull for any purpose, as for tumor or Gasserian ganglion removal, amputations, resections, bone transplantation, and in osteomyelitis to prepare the cavity for iodoform or bismuth paste.

The method consists in cutting a fragment of soft tissue, muscle or fascia, preferably muscle, from any convenient place in the field of operation and applying the fragment to the bleeding surface or edge of the exposed, broken, or cut bone by means of the fingers. If the tissue does not adhere at once it should be rubbed into the bleeding area by some suitable instrument, as a knife handle, dissector, or chisel, so that the vascular openings in the bone become plugged with little fragments of soft tissue. The advantages are obvious—the material is always present, it does not require special preparation, it does not act as a foreign body, and, according to my experience, it is always efficient.

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Ibid.: N. Y. Med. Journal, Feb. 17, 1906.
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p. 2111 (abstract).
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Da Costa: Modern Surgery, 1910, Sixth Edition, p. 452.

*Read by title at the meeting of the Southern Surgical and Gynæcological Association, Dec., 1912.

AN OPERATING TABLE FOR USE IN ANIMAL RESEARCH.

BY KATHARINE STEBBINS,

OF NEW YORK.

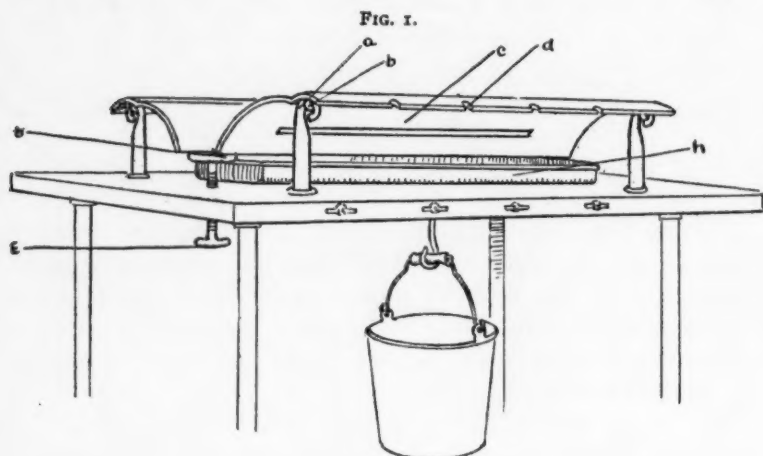
Nurse in charge of the Surgical Research Laboratory of the Department of Surgery, in the College of Physicians and Surgeons, Columbia University.

THE animal operating tables in use in the Surgical Research Laboratory of Columbia University are the result of a year's experience with the ordinary type of wooden rack and a constant consideration of its faults, with a view to producing a device of such construction and material as to meet every demand of convenience and asepsis.

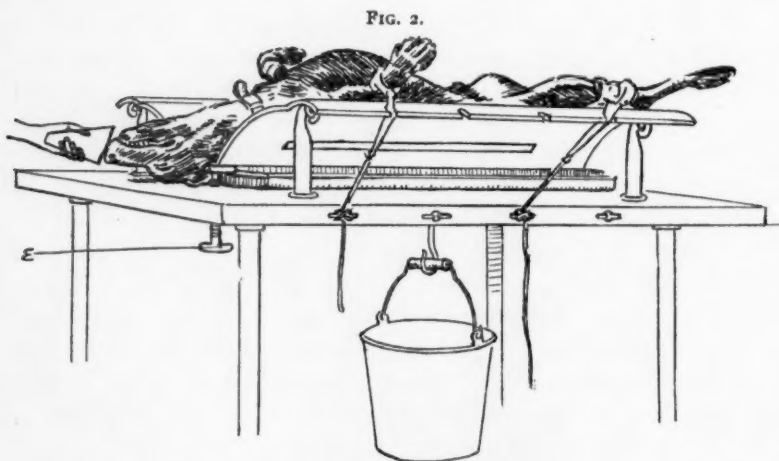
The most obvious faults in the usual rack are, first, its inflexibility, making it difficult to adjust animals of various sizes; second, the absorbability of the wood if unpainted, and the impossibility of covering with a paint which will not stick to the animals' fur when wet with chemicals or blood; third, the difficulty of convenient drainage; and, most important of all, fourth, the impossibility of being assured that the experiments are carried on under conditions of proper asepsis. In the use of dogs of the available type, where the skin and hair are particularly difficult to clean, the latter objection becomes a serious one. In order to overcome these various faults, and at the same time to produce an operating table sufficiently inexpensive to be practical for the research laboratory, the outfit shown in the accompanying sketch has been devised by the writer.

Four posts of enamelled iron are screwed to the surface of a table. At the top of the post is a hook (*a*), so curved as to interlock and form a hinge with a lug (*b*) on the under side of the adjustable leaf (*c*). These leaves are also of enamelled iron, with a groove along the upper edge fitting over the top of the posts, to make the hinge turn smoothly and give support at every angle, and are shaped to form the sides of a trough which receives the animal's body. On the upper edge of each leaf is a series of notches (*d*), through which pass the ropes for fastening the limbs, and which are made fast to small cleats on the edge of the table. The trough is made of the desired

depth, to fit any animal from a cat or rabbit to a large dog by adjusting a screw (*e*) under the table. This screw raises or



lowers a strong cross-bar (*f*) by means of a centre, and the lower edges of the leaves rest on this cross-bar. Two longitudinal slits in the leaves, and the aperture between the lower edges,



allow for drainage into a shallow pan (*h*) on the table. A pail hung on a hook beneath the table receives the drainage

through a hole in the pan and in the table. The *open* hinge permits the leaves to be entirely lifted off the hooks and thoroughly washed with antiseptics, or put into the steam sterilizer if desired, while the simplicity of construction makes every part of the table accessible for cleaning.

Fig. 1 shows the table as in use at Columbia University, but its form makes it equally desirable for physiological or pathological research. Fig. 2 shows a large dog anæsthetized and fastened to the table with the leaves at the lowest point, giving a trough five inches deep. By turning the screw (*e*) the trough is at once changed to a depth of two inches, if desired. The entire outfit of four posts, two leaves, screw, and drainage pan may be attached to any wooden table in a few minutes.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY.

Stated Meeting, held December 11, 1912.

The President, DR. CHARLES L. GIBSON, in the Chair.

COMPLETE SEVERANCE OF ALL STRUCTURES ON THE FLEXOR SURFACE OF THE WRIST: TENORRHAPHY AND REPAIR.

DR. W. S. SCHLEY presented a man, 28 years old, who fell from a step-ladder through a glass door, and in trying to save himself thrust his arms forward. The right wrist came in contact with a sharp edge of glass, and every structure upon the anterior aspect was divided to the bones (Fig. 1). A nearby physician placed a tourniquet on the arm, and the man was sent to the hospital. After securing the ulnar and radial vessels, the wound was thoroughly irrigated with saline solution, and immediate suture of the divided tendons begun. To locate the retracted proximal ends and secure sufficient working space, a five-inch incision was made up the middle of the forearm, crossing the wound at its centre. Much difficulty was experienced in securing each tendon to its distal end, and the procedure was like trying to repair broken wires of a telephone switch-board. The median, radial and ulnar nerves were completely divided. The tendon sheaths were incised to secure the proximal ends, and the tendons were sutured with a mattress suture of fine silk. The divided ends of the median nerve were stitched with fine catgut. The ulnar and radial nerves were not sutured.

The forearm and hand were put up in half flexion and kept so for three weeks. Primary union resulted in the first week. The point of interest in the case was the very extensive injury, with practically complete restoration of function after seven months. For five months the resulting anæsthesia in the hand and fingers was the cause of many minor burns and injuries. At the present time, the atrophy of the thumb and little finger muscles was fast disappearing. There was some hyperæsthesia, and over the median nerve at the site of the injury there was a small, very sensitive mass, probably a neuroma or neurofibroma. No ulnar neuritis had developed. The circulation in the hand was apparently slightly interfered with following the division of the radial and ulnar vessels, although in cold weather the hand on the in-

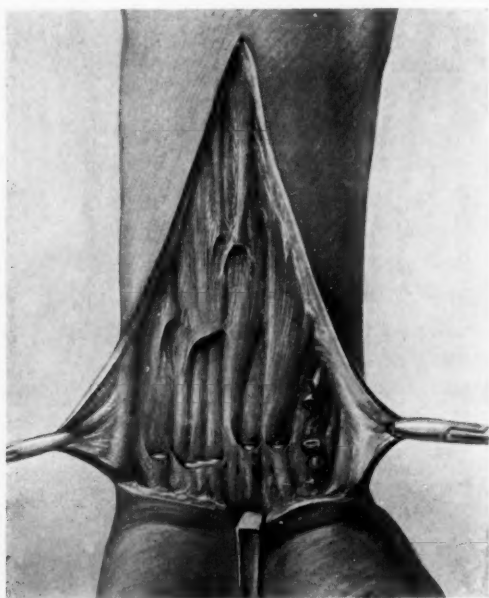
M 700

FIG. 1.



Semi-schematic drawing. Severance of all structures on anterior surface of wrist.

FIG. 2.



Severance of tendons and superficial layer of wrist.

jured side suffered more than its fellow, and the circulation was not as good; this gave the patient but slight inconvenience.

COMPLETE SEVERANCE OF SUPERFICIAL LAYER OF FLEXOR
TENDONS OF WRIST: TENORRHAPHY.

DR. SCHLEY presented a boy, ten years old, who while turning the knob of a glass panel door loosened a sheet of broken glass, which in falling passed across the anterior aspect of the wrist, half an inch above the annular ligament. The radial artery and all the superficial tendons were completely divided, and the median nerve was badly nicked (Fig. 2). The artery was ligated, and the skin wound was sutured by a physician, who gave a very bad prognosis as regarded function. When Dr. Schley saw the boy, a week after the accident, the wound had become badly infected. It was reopened, and about four weeks were allowed to elapse before it was thought safe to attempt tendon repair. An incision four inches long was made along the anterior aspect of the forearm, crossing the original cut, and as each divided tendon was found it was freshened and sutured to its distal segment with a single mattress suture of fine silk. The retraction of the tendons had been so considerable that the sheaths had to be incised. No attempt was made to do anything to the median nerve, as it had been only partly divided. The arm and wrist were then put up in half flexion. For three months following injury there was noticeable impairment of function of the thumb muscles—the opponens, abductor, and flexor brevis pollicis. Result perfect; motion as free and strong as before.

OSTEOPLASTIC CRANIECTOMY ILLUSTRATING THE USE
OF THE DE MARTEL APPARATUS.

DR. JOHN A. HARTWELL, presented a man, 33 years old, who was admitted to the hospital on November 15, 1912, complaining chiefly of headaches and twitching of the right side. The history he gave was that seven weeks prior to his admission he was struck on the upper posterior portion of the left frontal bone with a heavy iron bar. He immediately felt numb and became unconscious, and when he awoke in the hospital six hours later he complained of feeling drowsy and had a sharp, lancinating pain in the left eye. He went to sleep again, and when he awoke, seven hours later, he had a very severe unilateral headache on the left side. During the first two days after his injury he suffered from nausea and vomiting, the latter being at times projectile in character. The headache gradually became less

severe, and the patient left the hospital 16 days after the receipt of his injury. On the afternoon of that day he had two attacks of dizziness and "giving way" of the right side, without premonitory symptoms. He did not lose consciousness entirely, but sank slowly to the ground and could not rise for four or five minutes. During the following six weeks he had about 15 similar attacks; these usually occurred in the afternoon, and were accompanied by aphasia. He usually fell to the right side, and after such a seizure complained of severe unilateral headache which persisted for the rest of the day and was somewhat alleviated by a night's rest. The patient also stated that about a week after the injury he became nervous and developed jerky twitching movements of the entire right side of the body. He described these as having their onset in the tips of the right fingers, and extending up to the arm and face and down the leg.

The headaches gradually became more severe and constant, and when the man returned to the hospital he was examined by Dr. M. Allen Starr, who expressed the opinion that the patient had an extensive cortical hemorrhage, with laceration of the meninges, and advised an exploratory trephine operation. In November, 1912, Dr. Hartwell, under gas and ether intratracheal anæsthesia, made an incision in the left temporal region, and then did an osteoplastic craniectomy, using the De Martel apparatus. There was very little bleeding from the bone, but considerable oozing from the surface of the dura, which was more adherent to the skull than usual. The dura was tense, but pulsating; it was incised and reflected, showing an apparently normal brain surface. The dura was sutured and wound closed. The patient made an uneventful recovery, and when he left the hospital, November 29, there had been no recurrence of his symptoms.

Dr. Hartwell also briefly reported a second case of osteoplastic craniectomy in which he used the De Martel apparatus. He referred to the ease and rapidity with which the skull could be opened by means of this instrument, and its comparative safety in guarding the dura from injury.

FRACTURE OF THE UPPER THIRD OF THE LEFT HUMERUS,
WITH A TRANSCONDYLOID FRACTURE OF THE
ELBOW: TREATMENT BY THE COMBINED
WHITMAN-JONES POSITIONS.

DR. H. H. M. LYLE showed a boy, five years old, who fell 20 feet, sustaining a fracture of the upper third of the humerus and

of both condyles of the left elbow. When he entered St. Luke's Hospital, 24 hours after the accident, the problem was to reduce and hold in good position the fragments of a bone which had been fractured at both extremities. The usual methods of holding the fragments were tried but gave disappointing results. Having observed the excellent results obtained by Dr. Royal Whitman in the treatment of epiphyseal displacement and fracture of the upper extremity of the humerus by assuring definite adjustment and fixation of the fragments, it was decided to treat the fracture of the upper third of the humerus in this manner, and the transcondyloid fracture by Jones's method of supination and acute flexion.

With the patient under ether, the fragments were separated, the upper fragment was grasped, and the arm slowly abducted to the extreme limit, the acromion serving as a fulcrum. The abducted arm was moved slightly forward, the forearm was supinated and acutely flexed. This position was maintained by a shoulder spica which extended from the wrist and inclosed the elbow, the arm, the shoulder and the thorax. Contrary to expectations, this position proved to be very comfortable, and at the end of four hours the swelling of the arm had disappeared. The bandage was removed on the 37th day, when both fractures were solidly healed and both joints allowed considerable motion. It was now a month since the bandage had been removed, and the boy had perfect functional use of both joints. A number of X-ray plates were exhibited by Dr. Lyle to show the anatomical results.

OBSTRUCTIVE JAUNDICE FROM AN IMPACTED STONE IN
THE COMMON DUCT: PERTHES'S INCISION; CHOLE-
CYSTECTOMY; CHOLEDOCHOTOMY.

DR. H. M. LYLE presented a woman, 57 years old, who entered St. Luke's Hospital on September 18, 1912, giving a history of gall-stones which extended over a period of 20 years. A year ago she had a severe attack of gall-stone colic, with a typical blockage of the common duct. Her jaundice still persisted and was now intense. She was weak and emaciated, and had lost over 60 pounds. A moderate grade of mitral insufficiency was present. The liver extended for two fingers' breadth below the free border of the ribs. The gall-bladder could not be palpated, and there was a marked diastasis of the recti.

The patient was regarded as a very bad surgical risk; it was reasonably certain that numerous adhesions would be encountered, and the conditions called for an incision that would give ample

room for rapid and thorough work. It was thereupon decided to employ Perthes's incision, which was hockey-shaped, the vertical arm starting in the median line just below the ensiform cartilage and descending to within two fingers' breadth of the navel; it then turned horizontally outward until the fibres of the external oblique were exposed. The anterior sheath of the right rectus was opened in the median line and the index-finger of the left hand inserted between the posterior surface of the right rectus and its posterior sheath. At the level of the transverse incision a double row of mattress sutures was inserted to bind the rectus muscle to the anterior sheath, the finger keeping the needle from penetrating the posterior sheath. The muscle was then cut transversely between the two rows of mattress sutures. The rectus muscle, bound to its anterior sheath, was then reflexed upward over the free margin of the ribs until the two intercostal nerves were seen entering the posterior surface of the rectus. An oblique incision, one finger's breadth below these nerves and parallel to the free border of the ribs, was made through the posterior sheath into the peritoneal cavity.

The advantages of this incision, Dr. Lyle said, were: (1) It gave an excellent exposure; (2) no nerves were cut; (3) the suture of the peritoneum and the posterior sheath in oblique incision was simple and this line of suture covered by the rectus; (4) it yielded a strong abdominal wall; in the rectus he substituted an artificial transverse fibrous band if he did not go through a natural one; (5) it afforded opportunity for work on the appendix, etc.

Dr. Lyle said he felt that in this particular instance without such an excellent exposure he would have lost the case. The patient's general condition was critical, and the dense adhesions surrounding the common duct were difficult to handle. The gall-bladder was excised, a large stone was removed from the common duct and four from the hepatic duct. The common duct was drained. The patient made an uninterrupted recovery and now possessed a strong abdominal wall.

The transverse division of the rectus, Dr. Lyle said, was described by Sprengel before the German Surgical Congress in 1910. In the *Zentralblatt für Chirurgie*, No. 24, June 15, 1912, page 809, he described a method of making the suturing of the transverse wound easier. Perthes, in the *Zentralblatt für Chirurgie*, No. 37, pp. 1249-1252, still further improved this

portion of the technic, and in the same number of the *Zentralblatt* (pp. 1252-1256) described his incision for operations on the gall-bladder and ducts.

GASTRECTOMY; CHOLECYSTECTOMY; CHOLEDOCHOSTOMY.

DR. JOHN F. ERDMANN presented a woman, 68 years of age, upon whom he had operated four years ago for a hydronephrosis of the right kidney, which contained a large number of small calculi, sufficient to fill a six-ounce bottle. At that time he did a nephrectomy, also removing an ovarian cyst and the appendix.

The patient remained perfectly well until a year ago, when she returned complaining of severe gall-bladder colic, together with pain after eating, loss of flesh, etc.—symptoms which led to the suspicion of a neoplasm of the stomach.

On June 22, 1912, Dr. Erdmann exposed the gall-bladder through a median incision, doing a cholecystectomy for atrophied gall-bladder which contained 112 stones. He also did a choledochostomy, removing 68 stones from the common and hepatic ducts.

There was present also an extensive but freely movable cancer of the pylorus, and a pylorotomy and partial gastrectomy was done, four-fifths of the stomach being removed. The patient recovered rapidly, and had gained 13 pounds in a few weeks.

CARCINOMA OF THE STOMACH: GASTRECTOMY.

DR. ERDMANN presented a man, 46 years old, upon whom he operated on October 22, 1912, for an extensive carcinoma of the stomach, necessitating the removal of four-fifths of the stomach, with the pylorus. Recovery was perfectly smooth, and the patient had been free from symptoms since the operation.

This patient had presented mixed symptoms suggestive of both ulcer and carcinoma. The pathological report showed that cancer was engrafted upon an ulcer.

In reply to a question by Dr. Gibson, Dr. Erdmann said that in 21 gastrectomies recently performed he had done the posterior gastro-enterostomy 19 times, and the anterior but twice.

PERFORATION OF THE UTERUS DURING CURETTAGE, WITH PROLAPSE OF THE GUT, NECESSITATING THE REMOVAL OF TWO FEET OF INTESTINE.

DR. JOHN F. ERDMANN presented a young woman whom he was called to see about three hours after she had been curetted in a physician's office for a suspected miscarriage. The duration of

the pregnancy was not over eleven weeks. Upon examination, he found the patient in a fair degree of shock, with considerable abdominal distention and tenderness. A large plug of cotton was found in the vagina, upon the removal of which a mass was seen protruding which resembled the umbilical cord of a full-term child. This could be drawn out of the vagina for a distance of about a foot, and proved to be intestine denuded of its mesentery.

The patient was hurried to a hospital, and Dr. Erdmann did an abdominal section, an hour later. He found the abdomen filled with blood-clots and some intestinal contents. The cæcum was markedly infiltrated with blood, excepting its outer aspect, and the mesentery was torn loose from the ileum for a distance of over two feet from the ileocæcal junction. This loop of intestine had escaped through a perforation in the uterus which was large enough to admit the thumb. The uterus was soft and boggy and enlarged to about a two months' pregnancy.

A resection of the intestine was done within one inch of the ileocæcal valve, and this one inch inverted into the cæcum. The proximal excision was done an inch beyond the point of denudation of the mesentery, and an ileocæcal side-to-side anastomosis made. A subtotal hysterectomy was done, the posterior wall of the cervix was split, with free iodoform packing drainage. The patient was discharged, well, at the end of three weeks.

Dr. Erdmann said he could recall four additional cases of perforation of the uterus during curettage that came to his service for surgical attention. In one he did a hysterectomy on account of a large laceration of the uterus. In this case there were numerous contusions of the intestines, but a resection was not necessary. In the second case a hysterectomy was done, with the removal of twelve inches of intestine and the repair of a large rent in the bladder. This patient died. In the third case the tear was in the cervicocorporeal junction, with no marked evidence of peritoneal involvement. Under simple drainage the patient recovered. In another case the conditions were so grave at the time that no operative procedure was entertained, and the patient died within two hours after he saw her.

MYOSITIS OSSIFICANS TRAUMATICA; THE DIFFICULTY OF DIAGNOSIS FROM SARCOMA.

DR. WILLIAM B. COLEY read a paper with the above title, for which see page 305.

BOOK REVIEWS.

SURGERY OF DEFORMITIES OF THE FACE, INCLUDING CLEFT PALATE. By JOHN B. ROBERTS, A.M., M.D., Professor of Surgery in the Philadelphia Polyclinic. Large octavo; 273 pages; 273 illustrations.

IN this book the author has summed up the experience of a long professional life during which plastic work about the face has especially engaged his attention. Contributions of a minor character covering operations in this field have from time to time issued from his pen. One characteristic of Dr. Roberts' work, which has always impressed his colleagues, is his absolute honesty, so that when any one takes up a volume from his pen they feel sure that in it there is a plain and unvarnished tale in which both the successes and failures, merits and demerits of the various procedures described will be set forth. The author's style is plain and simple and his statements are so expressed as to convey their meaning to the reader without any question. The illustrations are abundant and have the rare merit of aiding the reader to understand the text. The author devotes two initial chapters to a historical account of the development of plastic surgery in general, then, after a survey of the anatomy of the face and the characteristics of the surgery of that region, he proceeds to a study of the principles of the special plastic procedures involved in the surgery of the region. Naturally the greatest interest in the surgery of this region attaches to the correction of harelip and cleft palate. The author devotes two chapters to this subject. His treatment of the subject is full and in general most satisfactory, but we could wish that he had emphasized with more detail the importance of preserving the intermaxillary bone. In the work of inexperienced surgeons,—and it is for them that this book is written,—this troublesome protrusion is too often sacrificed, because its importance for the future development of the jaw and for the prevention of most lamentable disfigurement, notwithstanding the repair of the fissured lip, is not sufficiently realized. A set of illustrations showing the later conditions produced by the loss of the intermaxillary

segment would not be difficult to get and would be most instructive. We do not wish to be considered as saying that the text anywhere suggests the sacrifice in any case of the protruding intermaxillary segment, but merely to express our opinion that it is an element in the subject which cannot be too fully dwelt upon. The importance of repairing by stages the more extensive defects of the palate and lip in the new born, also, cannot too strongly be set forth. This is well stated in the recapitulation which the author gives at the close of his discussion of the various operative stages required for the complete procedure which, as he says, may occupy a year or two during which many periods of inactivity are furnished in order to insure safety to the child and permit the surgeon to see the effect of the various stages of his operative work.

Deformities of the nose with rhinoplasty receive full attention, and here we recognize the result of the special interest with which the author has followed the surgery of this region for so many years.

The book as a whole is of great interest, and we are indebted to the author for giving to his colleagues this valuable summary of the work of a long professional life. LEWIS S. PILCHER.

DEFORMITIES INCLUDING DISEASES OF THE BONES AND JOINTS.

A Text-book of Orthopædic Surgery, by A. H. TUBBY, M.S. (Lond.), F.R.C.S. (Eng.). Second Edition. Macmillan and Co., London and New York.

The first edition of Tubby's book appeared fourteen years ago. It represented the English point of view, that orthopædics was concerned with the treatment of actual deformity only. That this convention no longer holds is evidenced by the fact that nearly a quarter of the book is devoted to the affections that lead to deformity, notably diseases of the bones and joints, in which rational and timely treatment may prevent the otherwise inevitable distortions.

The work is divided into ten sections. Five are included in the first volume under the titles of congenital and static deformities, and diseases of muscles, tendons, and fasciæ. In the second, are diseases of the bones and joints and paralytic deformities.

The author states that he has discarded the regional arrange-

ment in favor of the more scientific classification on an etiological and pathological basis. As deformities have such diverse causes, no arrangement can be perfectly satisfactory, and from the practical diagnostic and therapeutic stand-point, it may be questioned if the present classification, which requires so much repetition, has any advantage. For example, static deformities are considered in Volume I, and rickets, one of the most common causes of static deformities, in Volume II. The treatment of acquired talipes, usually caused by paralysis, is discussed in Volume I, while paralytic affections, including operative treatment by muscle transplantation, of which the chief value is in the treatment of distortions of the feet, are in Volume II.

As contrasted with the first edition, the contents of the two volumes are almost encyclopædic in range, and together with the illustrations it has been drawn from all sources, this country furnishing by far the largest proportion. It has been the author's intention to prepare an account of orthopædic surgery as it stands to-day, and he has presented the representative material so impartially that his own views and practice are not always well defined. It is evident, however, that he does not favor plaster supports. The Calot modification of the plaster jacket, generally recognized as a more efficient appliance than the original form, particularly in the treatment of disease of the upper and middle region of the spine, is not mentioned.

The various forms of plaster spicas used in the treatment of hip disease are not described. The author favors the Thomas brace, which is rarely applied in this country, and he describes at some length certain of the traction braces at one time a routine in treatment, but now in great degree displaced by apparatus that assures better fixation of the joint.

The author condemns the Mikulicz operation for torticollis, and prefers in certain instances the gradual rectification of deformity after tenotomy to immediate overcorrection.

Some of the operations described for the correction of deformity might be omitted with advantage; for example, that of Ogston for knock-knee, by separation and displacement of the internal condyle of the femur, which, it may be assumed, has long since been discarded. On the other hand, there is no note of the operative treatment of Pott's disease for the purpose of inducing ankylosis at the seat of disease, which is at present

attracting much interest. It is true that the first paper on the subject is not yet two years old, but the article by Lange on buried metallic supports in which the question of bone transplantation is discussed and which is undoubtedly entitled to priority, in suggestion at least, is of much earlier date.

The Abbott treatment for lateral curvature of the spine which bids fair to displace all other methods of treating fixed deformity, first described in June, 1911, has also escaped the author's notice. That two methods of treatment should have not only been suggested but sufficiently tested as to assure for themselves permanent places in practice, since the completion of this book, is gratifying evidence of the activity in this branch of surgery in this country.

The figures are numerous and well chosen to illustrate the diseases and deformities, and the methods employed in treatment. The bibliography is accurate and complete.

The size and cost of the work and its method of construction may limit its availability as a text-book, other than for reference, but it is heartily recommended to those who may have especial interest in or some knowledge of the subject. The author states that if he had appreciated the magnitude and difficulty of the task, it is possible that his courage would have failed. One may congratulate him therefore upon the very satisfactory result of his labors.

ROYAL WHITMAN.

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